# 4. TRANSPORT FROM THE SAN FRANCISCO BAY AREA TO THE NORTH CENTRAL COAST AIR BASIN

This section presents the analysis results for the North Central Coast Air Basin (NCC) as the receptor area, including the documentation of the ozone violations in the area and the analyses of air-parcel trajectories and precursor contributions. The methods that were used to perform the analyses were discussed in Section 2 and are not repeated here.

The North Central Coast Air Basin is defined as the counties of Santa Cruz, Monterey, and San Benito. The major upwind area which might contribute transported pollutants to the North Central Coast Air Basin is the San Francisco Bay Area Air Basin (SFBAAB). Figure 4-1 is a map of the general area which shows these two areas, plus the San Joaquin Valley.

## 4.1 OZONE VIOLATIONS IN THE NORTH CENTRAL COAST AIR BASIN

This subsection presents a general description of the ozone air quality in the North Central Coast Air Basin (NCC). The purpose of this analysis is to provide an objective understanding of ozone air quality at the receptor sites in that area; thus providing a basis for the more-detailed interpretative analyses in the following sections. The results in this section include basic statistics on where, when, and how often high ozone concentrations occur in the area and discussions of diurnal patterns of ozone concentrations.

Long-term ozone records are available from only two sites in the North Central Coast Air Basin, Hollister and Salinas. Ozone monitoring has been performed in the Carmel Valley since 1980, but at two different locations with no ozone monitoring in 1982. Ozone monitoring has been performed in Gilroy since 1980; this site is on the upwind border between the North Central Coast Air Basin and the San Francisco Bay Area. A number of other monitoring sites in the area have been operated for periods of at least two years during 1980-1989. Ozone monitoring has been conducted at Pinnacles National Monument since April 1987. However, these data were not received in time to be included in the summary statistics for this report.

The top part of Table 4-1 shows summary statistics for ozone concentrations exceeding the state standard at North Central Coast Air Basin monitoring locations and at Gilroy for the years 1980-1989. The table includes the total number of days exceeding the state standard and the average number of days per year. The table also lists the years of operation for each site. Note that monitoring did not always start at the beginning of a year, so there are a few partial years included in the data. The federal ozone standard was only exceeded at NCC monitoring sites on only five days during this period: three times at Hollister and once at Carmel Valley during 1980 and 1981, and once at Carmel Valley in 1989. Because there were so few exceedances of the state and federal ozone standards, we also computed the summary statistics for ozone concentrations exceeding a lower cutpoint of 7 pphm (see the bottom part of Table 4-1). Figures 4-2, 4-3, and 4-4 show the monthly frequency of days with ozone concentrations exceeding 7 pphm at the

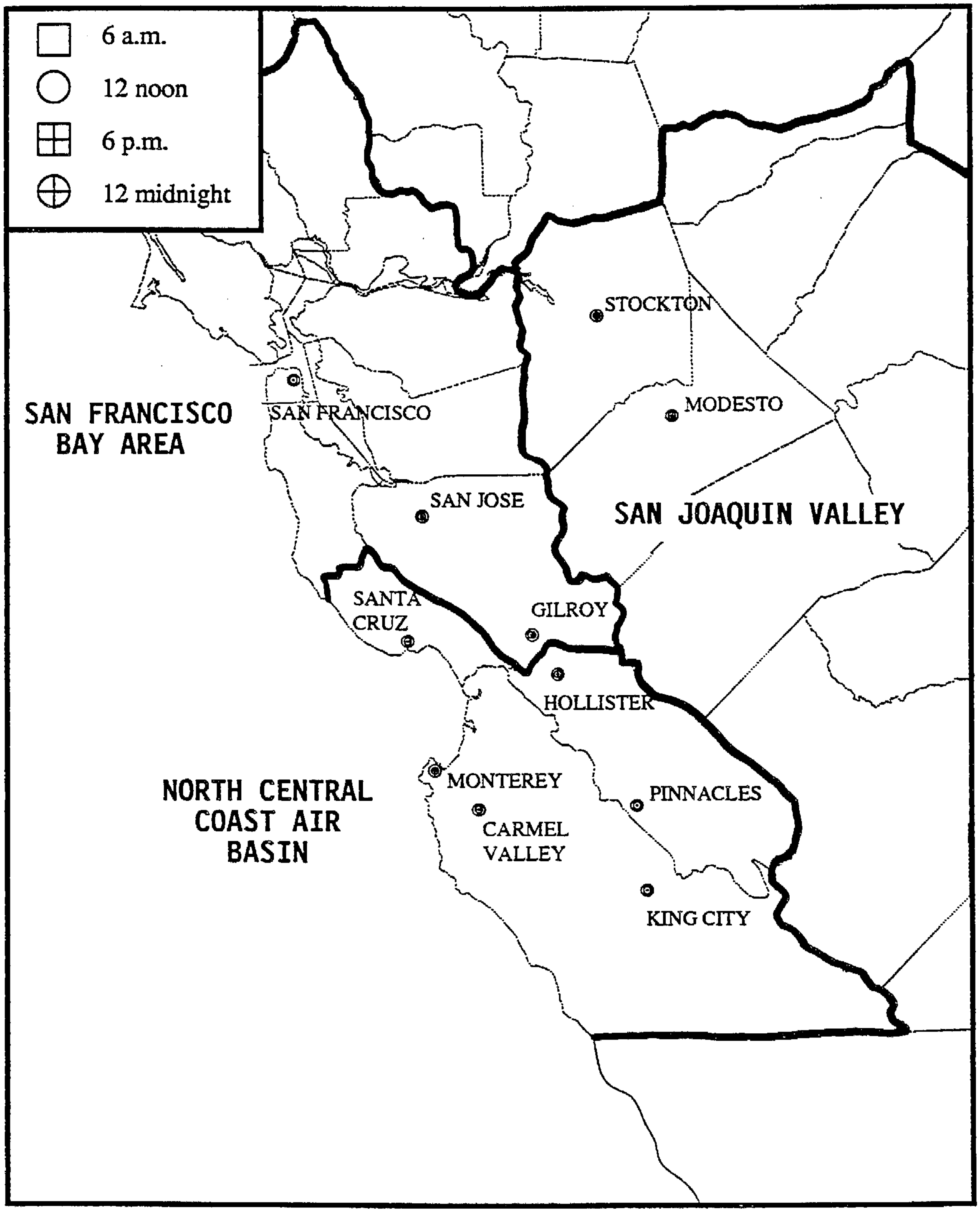


Figure 4-1. Map Showing San Francisco Bay Area, the North Central Coast Air Basin, and the San Joaquin Valley.

Table 4-1. Ozone Exceedances at North Central Coast and Nearby Monitoring Sites

Number of Days with Maximum Ozone > 9 pphm

| Site Name | Site Number | Years of Operation* | Total | Average Per Year |
|---|---|---|---|---|
| Gilroy | 43389 | 1980-1989 | 172 | 17 |
| Hollister | 35823 | 1980-1989 | 53 | 5 |
| Scotts Valley | 44848 | 1980-1983 | 8 | 2 |
| Aptos | 44845 | 1980-1984 | 5 | 1 |
| Santa Cruz | 44850 | 1984-1989 | 2 | <1 |
| Davenport | 44851 | 1987-1989 | 1 | <1 |
| Salinas | 27544 | 1980-1989 | 1 | <1 |
| Gonzales | 27537 | 1985-1987 | 0 | 0 |
| Monterey | 27538 | 1980-1983 | 2 | <1 |
| Carmel Valley | 27539 | 1980-1981 | 4 | 2 |
| Carmel Valley | 27550 | 1983-1989 | 5 | <1 |

Number of Days with Maximum Ozone > 7 pphm

| Site Name | Site Number | Years of Operation* | Total | Average Per Year |
|---|---|---|---|---|
| Hollister | 35823 | 1980-1989 | 259 | 26 |
| Scotts Valley | 44848 | 1980-1983 | 41 | 10 |
| Aptos | 44845 | 1980-1984 | 49 | 10 |
| Santa Cruz | 44850 | 1984-1989 | 50 | 8 |
| Davenport | 44851 | 1987-1989 | 4 | 1 |
| Salinas | 27544 | 1980-1989 | 19 | 2 |
| Gonzales | 27537 | 1985-1987 | 11 | 4 |
| Monterey | 27538 | 1980-1983 | 19 | 5 |
| Carmel Valley | 27539 | 1980-1981 | 10 | 5 |
| Carmel Valley | 27550 | 1983-1989 | 77 | 11 |

* Note that monitoring did not always start in January. Ozone data for July through September available if listed, at a minimum.

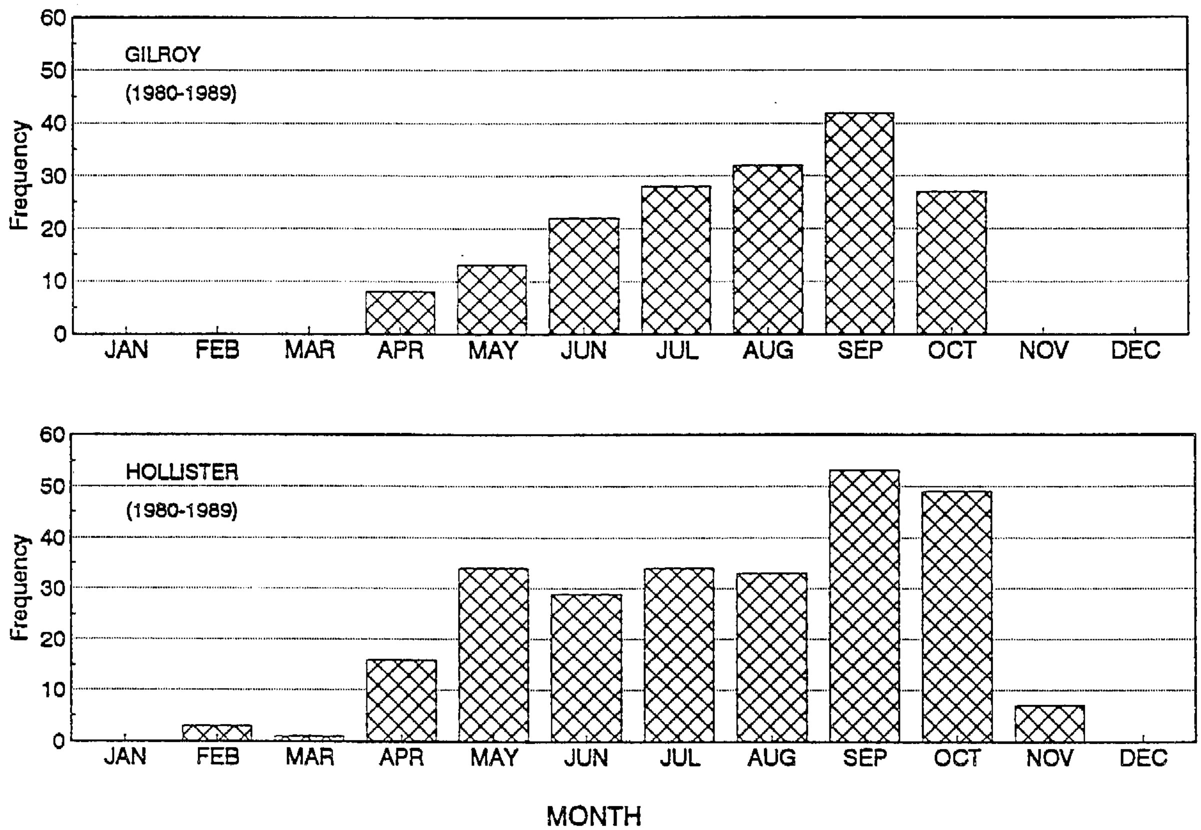


Figure 4-2. Monthly Frequency of Days With Ozone Maximum Concentration Exceeding 7 pphm at Gilroy and Hollister.

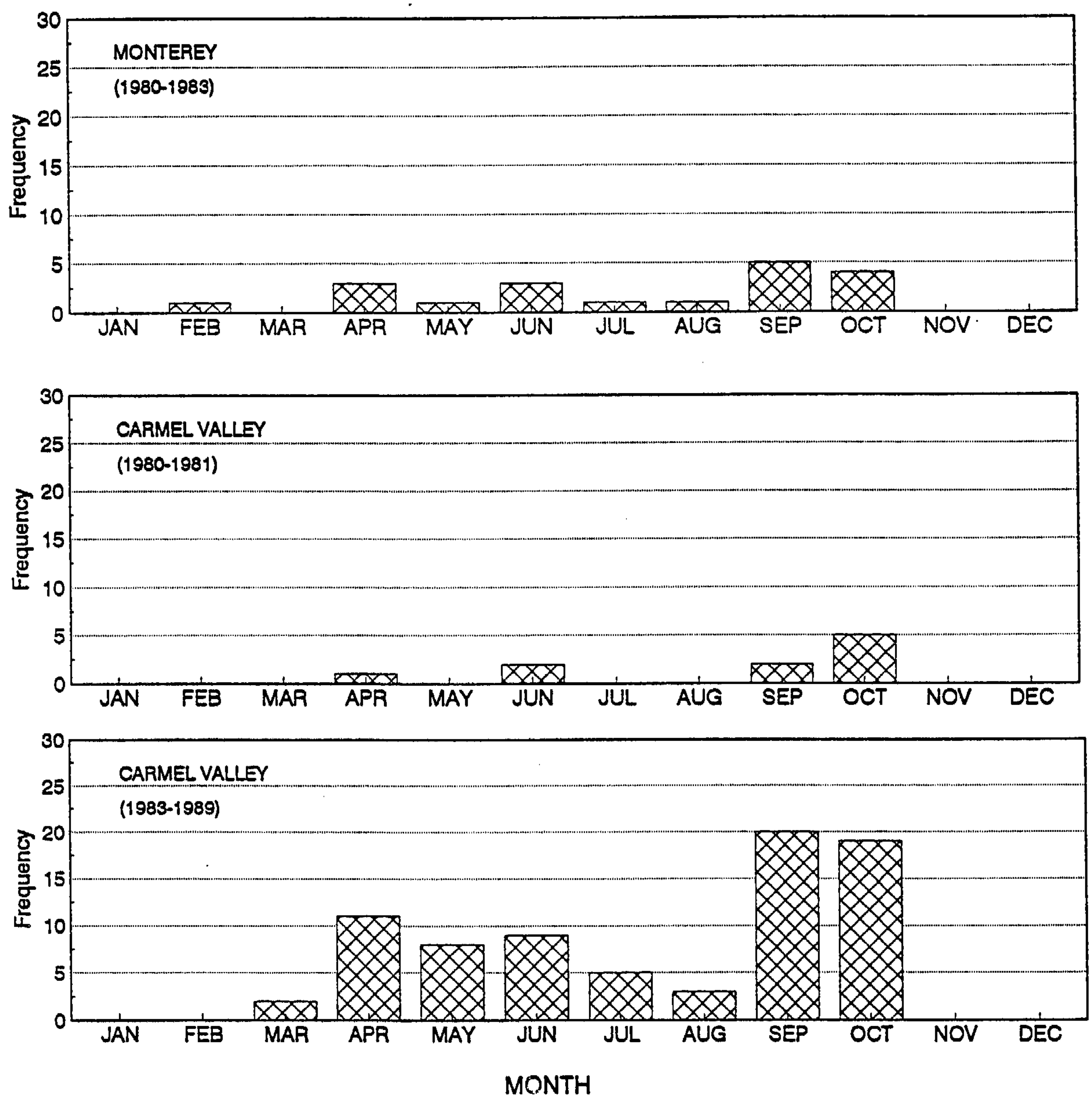


Figure 4-3. Monthly Frequency of Days With Ozone Maximum Concentration Exceeding 7 pphm at Monterey and Carmel Valley.

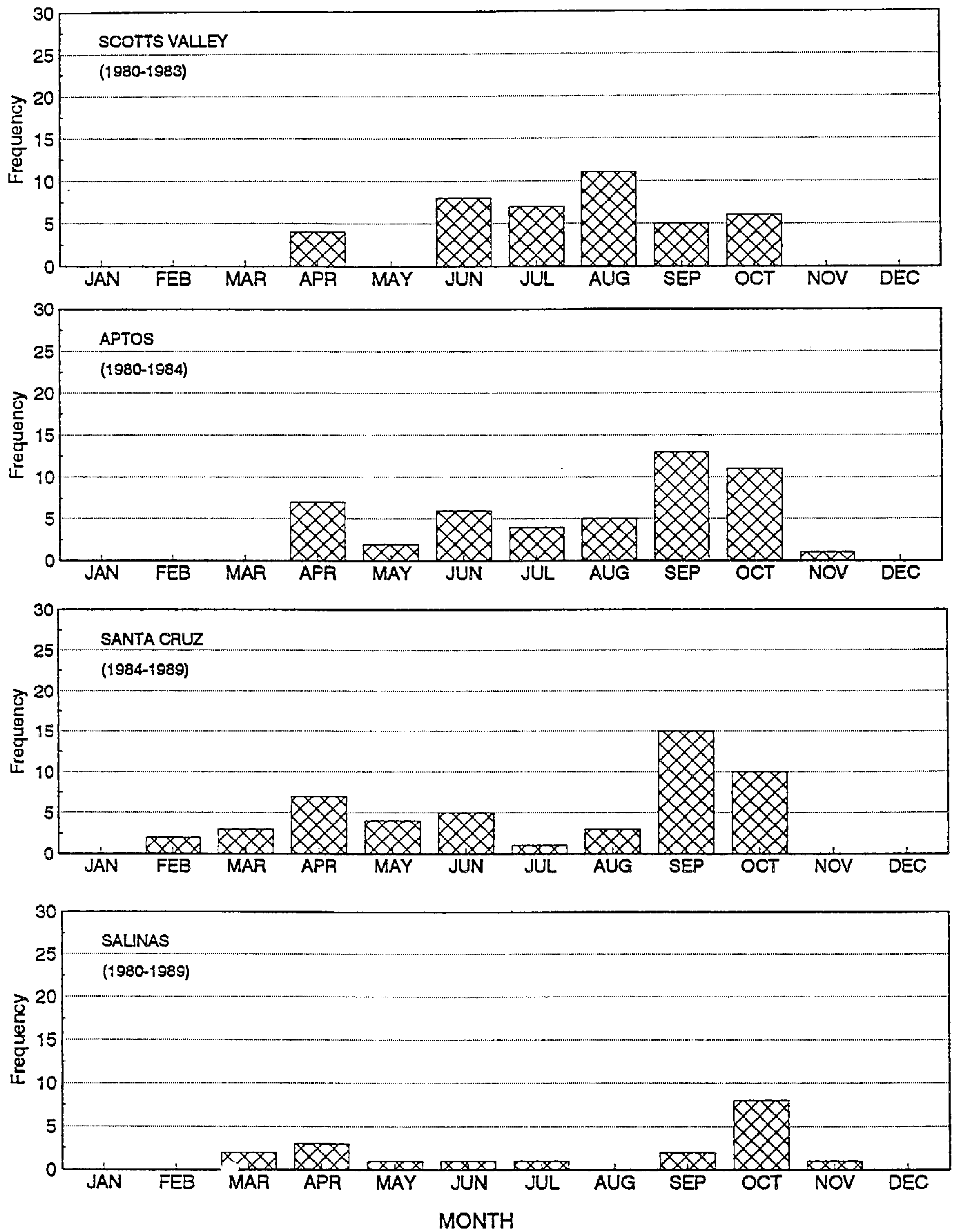


Figure 4-4. Monthly Frequency of Days With Ozone Maximum Concentration Exceeding 7 pphm at Scotts Valley, Aptos, Santa Cruz, and Salinas.

North Central Coast Air Basin monitoring sites and at Gilroy. Data from the Davenport monitoring site were not included since there were only four days with ozone concentrations over 7 pphm.

The table and figures give a useful summary of ozone conditions in the North Central Coast Air Basin. As indicated in the table, the yearly frequency of ozone exceedances is highest at Gilroy and at Hollister, with significantly lower frequencies at the other NCC monitoring sites. There were about 10 days per year exceeding 7 pphm at a number of monitoring sites, including Scotts Valley, Aptos, Santa Cruz, and Carmel Valley (1983-1989). The high frequency at Hollister, located on the upwind border of the North Central Coast Air Basin, is consistent with pollutant transport from the San Francisco Bay Area.

The figures show that most of the days with high ozone concentrations in the North Central Coast Air Basin occurred during the months of April through October. Exceedances at Gilroy and Hollister occurred most frequently during September, but also fairly evenly from May through October. At most of the other monitoring sites, especially Carmel Valley (1983-1989), days with high ozone concentrations occur most frequently in September and October with few such days during other months. Days with high ozone concentrations at Scotts Valley are more evenly distributed from June through October.

Figures 4-5, 4-6, and 4-7 give the hourly mean, minimum, and maximum ozone concentration for days with high ozone concentrations at the North Central Coast Air Basin monitoring locations. The relative timing of the diurnal ozone peak varies by location and is summarized below:

| Location | Time (PST) of Mean Ozone Concentration Peak | Time (PST) of Highest Ozone Concentration |
|---|---|---|
| Gilroy | 1300-1500 | 1500 |
| Hollister | 1300-1400 | 1400-1600 |
| Monterey | 1500 | 1500 |
| Carmel Valley | 1300-1500 | 1100-1600 |
| Scotts Valley | 1300-1500 | 1100-1600 |
| Aptos | 1300 | 1200-1400 |
| Santa Cruz | 1200-1300 | 1300-1400 |
| Salinas | 1400-1500 | 1400-1500 |

The time of the peak concentration can be an indicator of source-receptor relationships. Most of the ozone peak times at NCC monitoring locations begin by about 1200-1300 PST, suggesting the effects of local and nearby sources. However, there are later peaks at all of the locations which indicate transport effects.

Considering that the Gilroy and Hollister monitoring sites are only about 18 km apart, the different shape and magnitude of the mean and maximum curves are surprising. The Gilroy curves have later and higher peaks. The Gilroy curves also decrease faster in the afternoon than the Hollister curves, indicating some type of cleanout mechanism at Gilroy. These results are consistent with the presence of a convergence zone between Gilroy and Hollister on many days; on these days, Gilroy is influenced by transport from

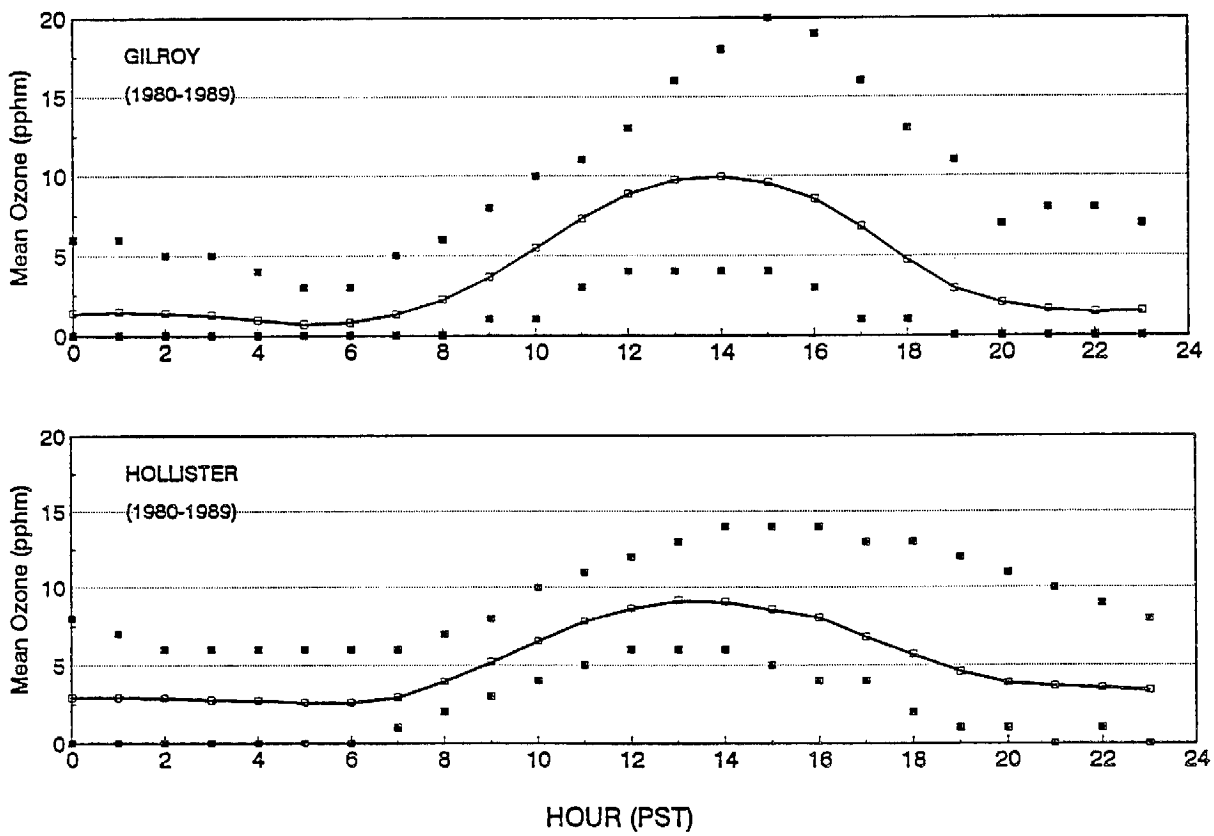


Figure 4-5. Hourly Mean, Minimum, and Maximum Ozone Concentrations for Days With Ozone Maximum Concentrations Exceeding 9 pphm at Gilroy and Hollister.

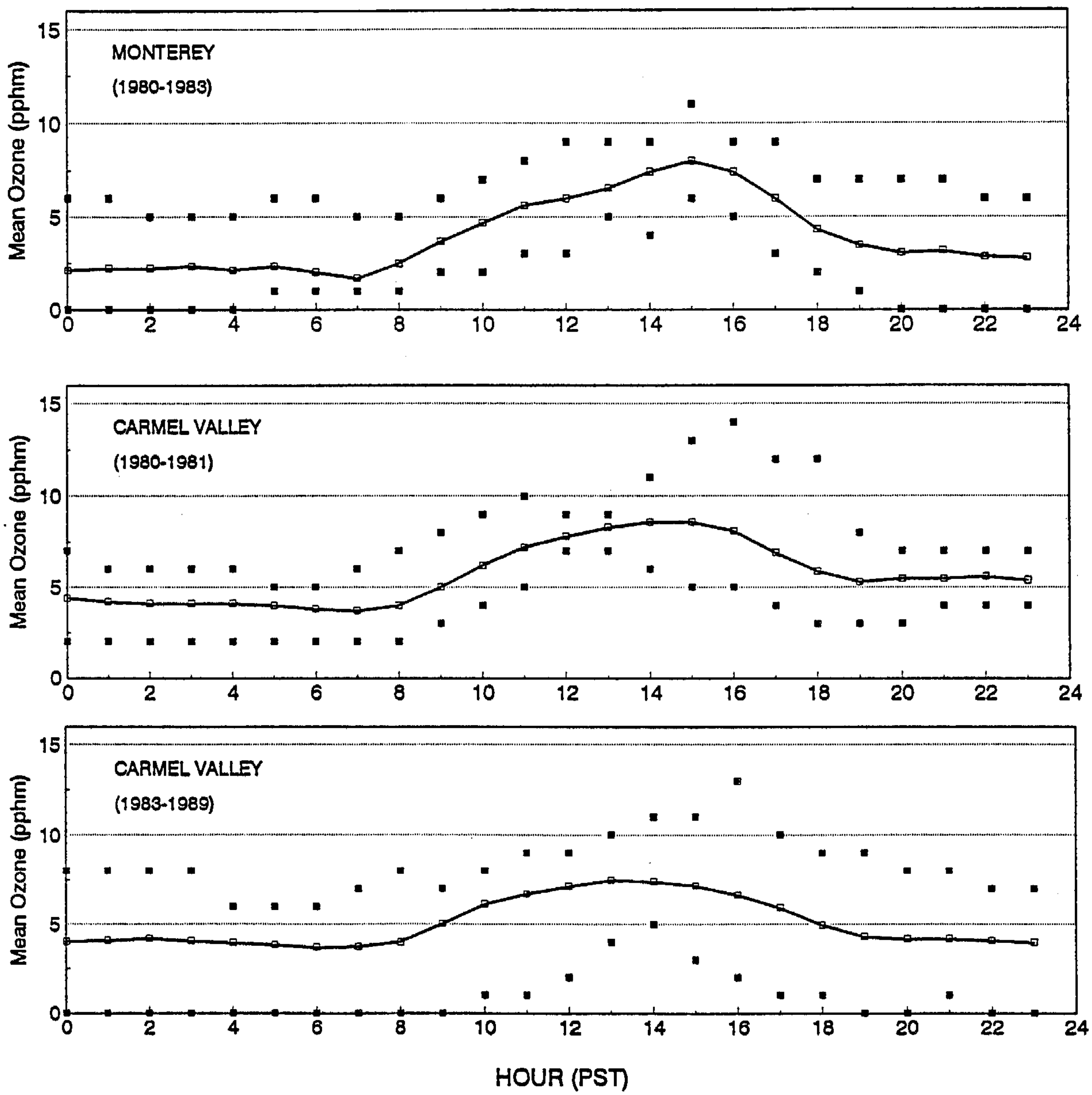


Figure 4-6. Hourly Mean, Minimum, and Maximum Ozone Concentrations for Days With Ozone Maximum Concentrations Exceeding 7 pphm at Monterey and Carmel Valley.

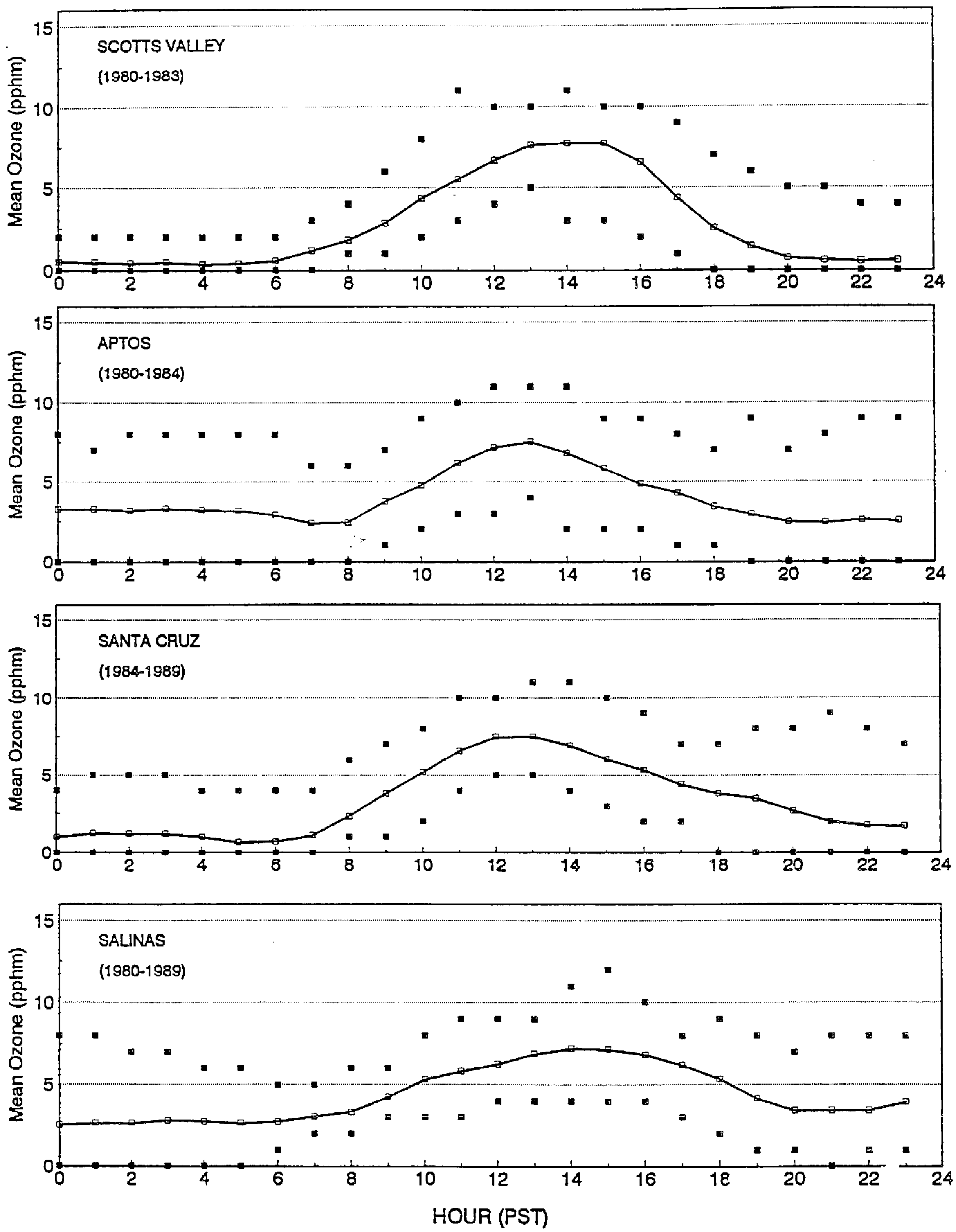


Figure 4-7. Hourly Mean, Minimum, and Maximum Ozone Concentrations for Days With Ozone Maximum Concentrations Exceeding 7 pphm at Scotts Valley, Aptos, Santa Cruz, and Salinas.

the Bay Area while Hollister is not. Also notice the wide variation in nighttime ozone concentrations from 0 to 7 pphm at Gilroy and Hollister. Sometimes these sites must be influenced by nighttime fresh emissions, but other times by transported pollutants.

The Carmel Valley mean, minimum, and maximum curves indicate somewhat different results. The mean curves peak during the early afternoon with a fairly-smooth shape. However, the hourly maximum curves show some high ozone concentrations early in the day (about 1100 PST) and some later (about 1600 PST). The early peaks are probably influenced by local or carryover sources while the later peaks are influenced by transport from sources further away. A review of individual diurnal ozone concentration profiles at Carmel Valley on these days did not identify any days with two peaks. Notice that the results from the two Carmel Valley monitoring sites are somewhat different. The mean curve for the 1980-1981 location has a higher and later peak than the mean curve for the 1983-1989 location. Also notice that at the old location on these days, the 1900-2300 PST mean ozone concentrations were higher than at the new location and the nighttime ozone concentrations never dropped to zero like they did at the new location. The overnight zeros at the new Carmel Valley monitoring site were all measured during two nights, June 20-21, 1989 and July 6, 1989.

The maximum ozone concentration curves for Aptos, Santa Cruz, and Salinas (see Figure 4-7) show ozone concentrations of 8-9 pphm on some evenings; this indicates some influence of late-arriving pollutant transport without titration with fresh emissions. A review of individual diurnal ozone concentration profiles at Aptos, Santa Cruz, and Salinas on these days identified a few days with evening second peaks, including the two-day episode of September 30-October 1, 1980 at Aptos. The second peak never had a concentration higher than the first peak or the state ozone standard.

Another way to evaluate the timing of peak ozone concentrations is to prepare frequency plots of the first hour of the maximum concentration (see Figures 4-8, 4-9, and 4-10). The maximum ozone concentration typically occurs first between 1200 and 1300 PST at all of these NCC monitoring sites except Monterey and Scotts Valley, where it occurs slightly later. This is quite early for long-range transport and indicates local, carryover, or short-range transport contributions.

## 4.2 TRANSPORT-PATH ANALYSES USING SURFACE DATA

This subsection summarizes the results of our trajectory analyses for the North Central Coast Air Basin and a discussion of those results. The purpose of these analyses is to evaluate if transport takes place, how often it occurs, and to estimate the general path of pollutant transport to the North Central Coast Air Basin.

To evaluate transport to the North Central Coast Air Basin, we selected the domain shown in Figure 4-11. This domain included the receptor sites in the North Central Coast Air Basin and the major upwind air basin, the San Francisco Bay Area. We also included the northern part of the San Joaquin Valley in order to complete the wind flow patterns out of the Bay Area. We

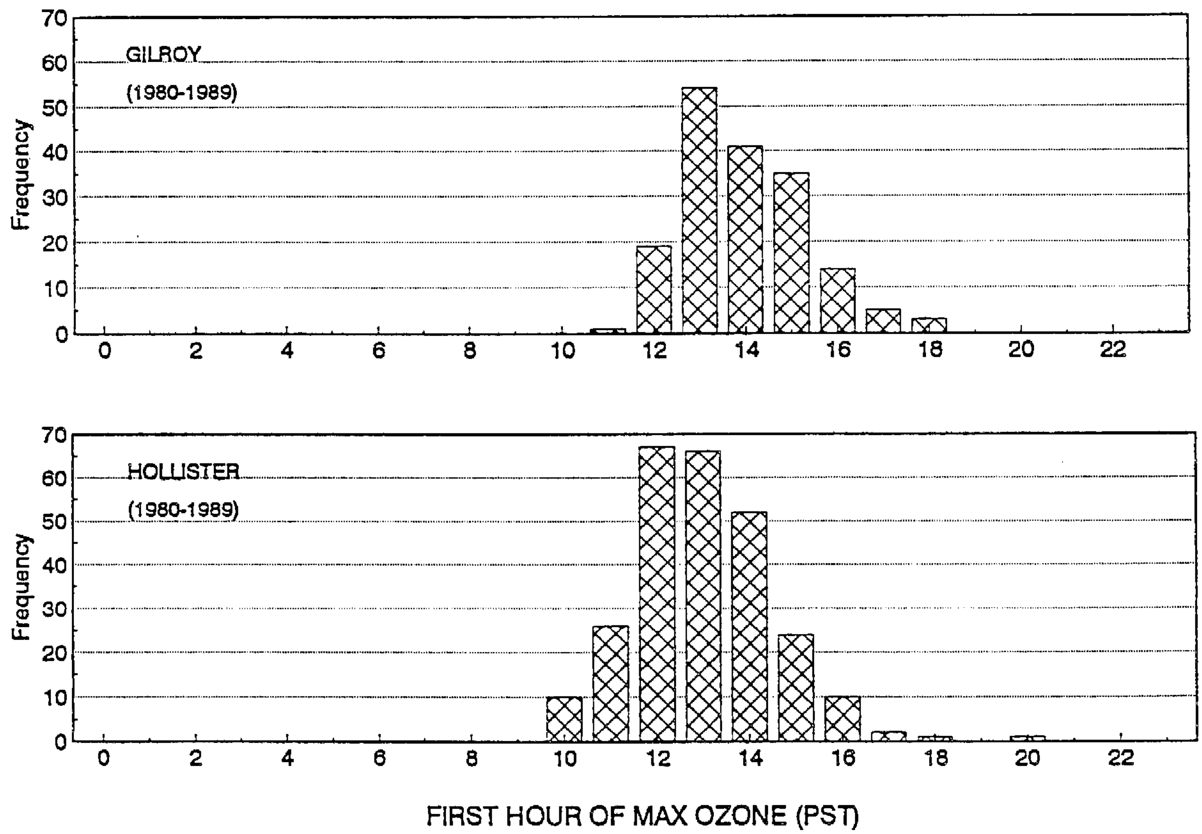


Figure 4-8. Frequency of First Hour of Maximum Ozone Concentration on State Ozone Exceedance Days ($O_3$ >9 pphm) at Gilroy and Hollister.

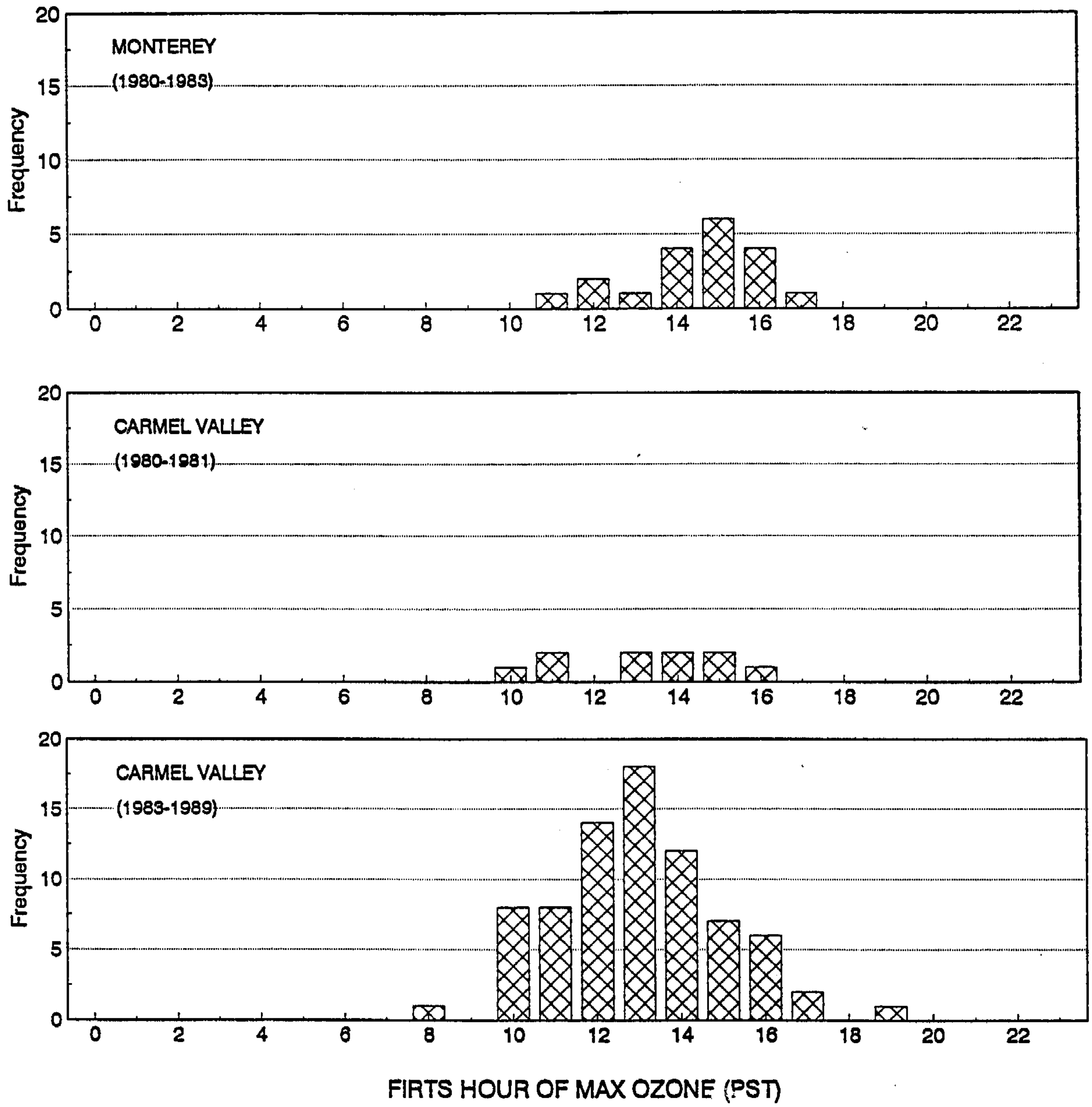


Figure 4-9. Frequency of First Hour of Maximum Ozone Concentration With Maximum >7 pphm at Monterey and Carmel Valley.

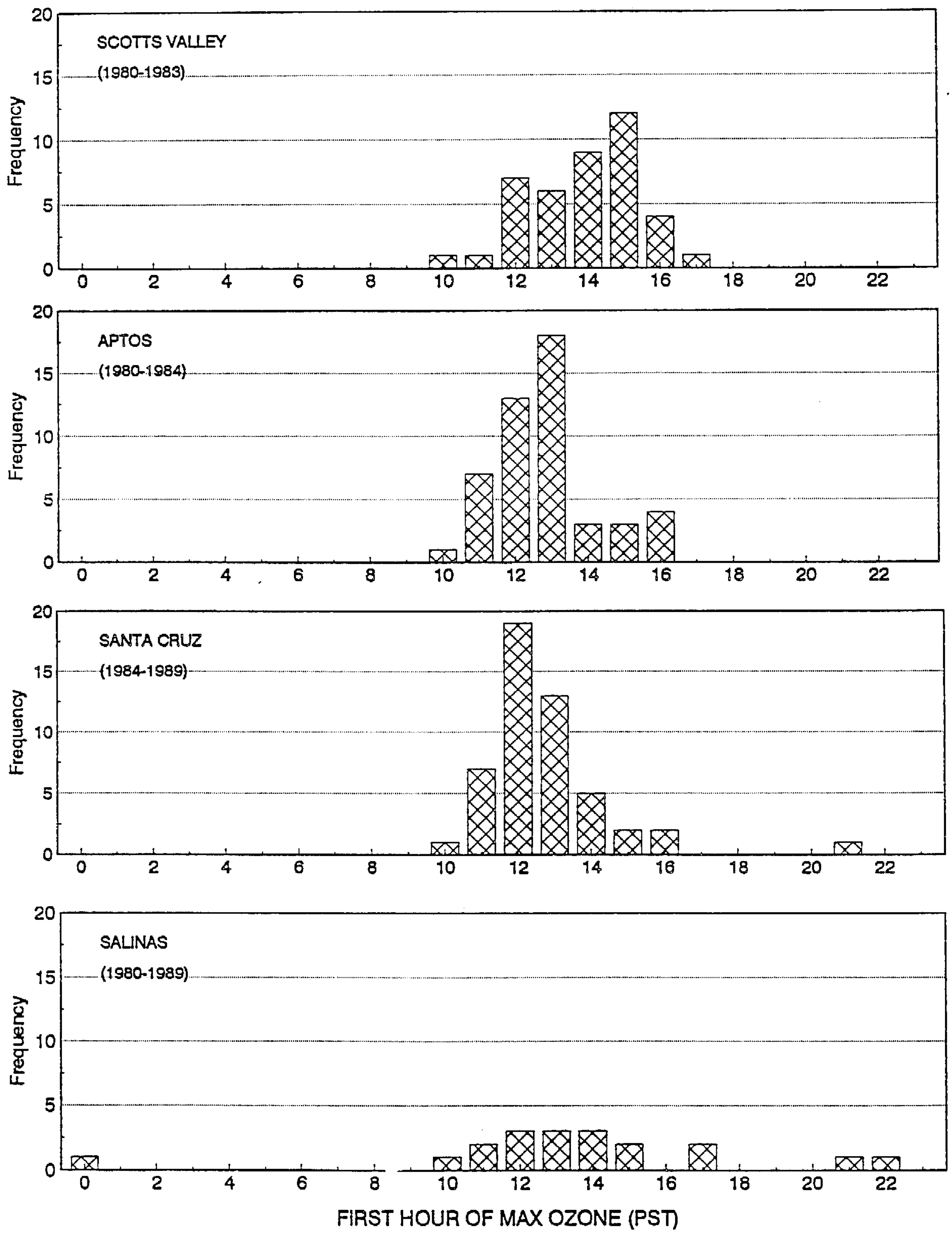


Figure 4-10. Frequency of First Hour of Maximum Ozone Concentration With Maximum >7 pphm at Scotts Valley, Aptos, Santa Cruz, and Salinas.

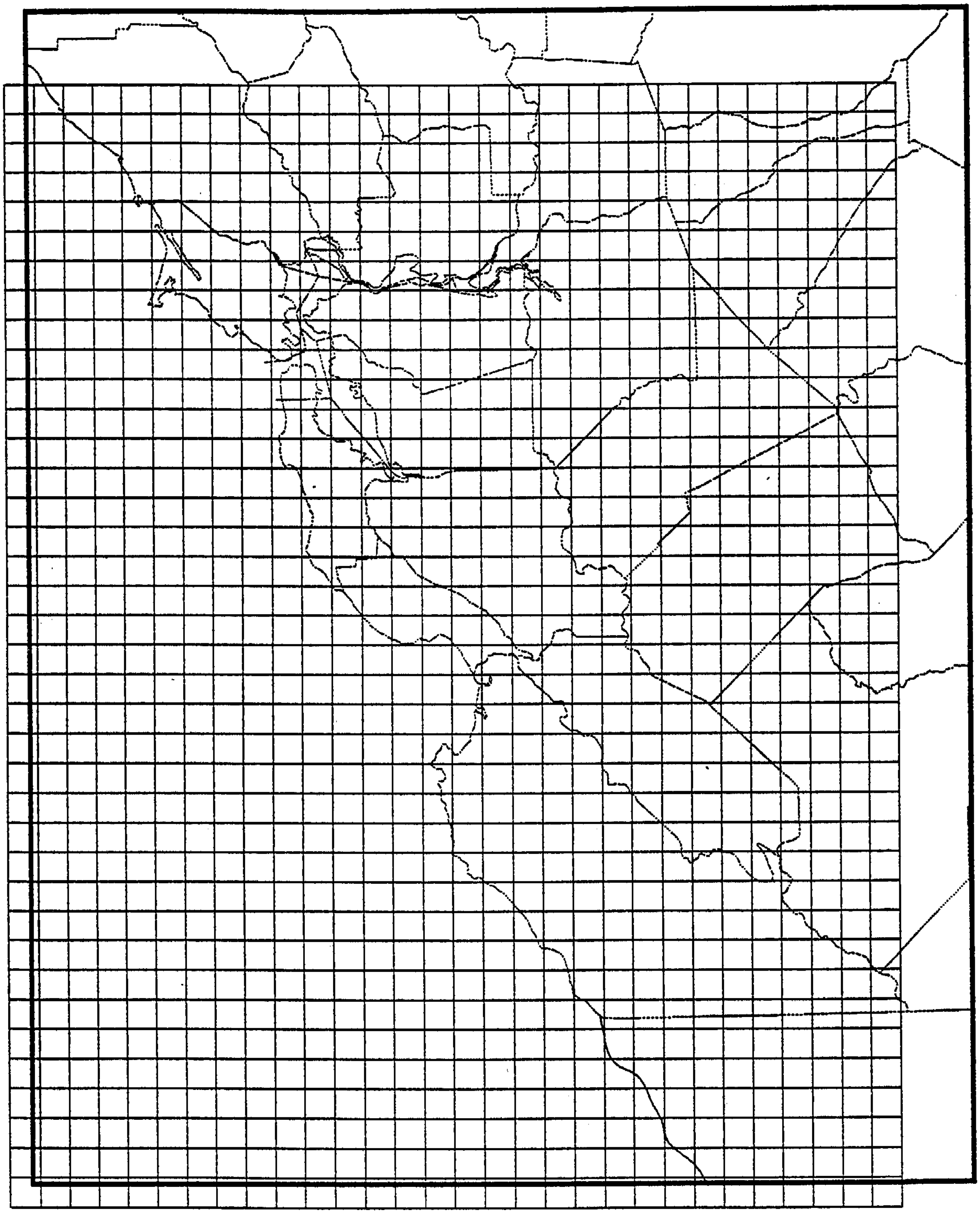

Figure 4-11. Map Showing Wind Field Grid for North Central Coast Trajectories.

used wind data from 88 surface wind measurement sites, including simulated buoys between existing buoys (at sites 43, 72, and 86) to fill in the windfields off the coast. The sites are shown on the map in Figure 4-12 and listed with UTM coordinates in Table 4-2. Data for a few of these sites are limited in duration, such as many of the new 10-meter towers installed by the Bay Area Air Quality Management District since 1989.

Based on the results in Section 4.1, we selected ozone exceedance days from the 1987-1990 period. The selections were based on days with the highest ozone concentrations at North Central Coast Air Basin monitoring sites, plus the availability of surface and aloft meteorological data. Data was missing for the Moss Landing surface meteorological site on all 1987-1989 exceedance days. Also, the BAAQMD 10-meter towers were not installed at San Martin and Gilroy until May 1987 and August 1989, respectively, and a meteorological site at Hollister was not installed until early 1990. These data gaps are a major limitation of any wind analysis because without good data in this area of the domain, the westerly flow from Monterey Bay toward the convergence zone in the Santa Clara Valley and flow near the convergence zone itself will not be properly represented. To test the importance of this, we prepared wind fields for several of the pre-1990 exceedance days and found flow in this area of the domain to be unrealistic. Wind flow in this area of the domain must be properly represented in order to understand the potential transport up the Santa Clara Valley to the Hollister monitoring site. Since these data gaps were major limitations, we concentrated our analyses on high ozone days during 1990.

During the summer of 1990, the San Joaquin Valley and AUSPEX (SJV/AUSPEX) field study was performed. The SJV/AUSPEX included additional surface and aloft meteorological measurements in the NCC area. We used the surface data in our analysis since it was quality assured. We planned to perform aloft trajectory and precursor contribution analyses using the aloft data; however, these data were not validated by the SJV/AUSPEX investigators in time to be used in this project.

We prepared wind fields for eight days in 1990. We then estimated forward and backward trajectories for selected locations and times. We prepared a total of 97 trajectories. The following discussion illustrates the general characteristics of those trajectories and summarizes the transport results.

Figures 4-13 through 4-17 illustrate various characteristics of the North Central Coast Air Basin trajectories for times of peak ozone concentrations. These trajectories were prepared using surface winds only; no aloft NCC wind data are yet available (as discussed above). If both surface and aloft trajectories were available, some of the conclusions discussed below might be modified.

Figure 4-13 shows a back trajectory from Hollister for 1300 PST on August 5, 1990; the trajectory for 1400 PST was similar. Figure 4-14 shows a back trajectory from Pinnacles for 1700 PST on August 5, 1990; the trajectory for 1900 PST was similar. Both trajectories show direct, same-day transport up the Santa Clara Valley with arriving air parcels that were in the South

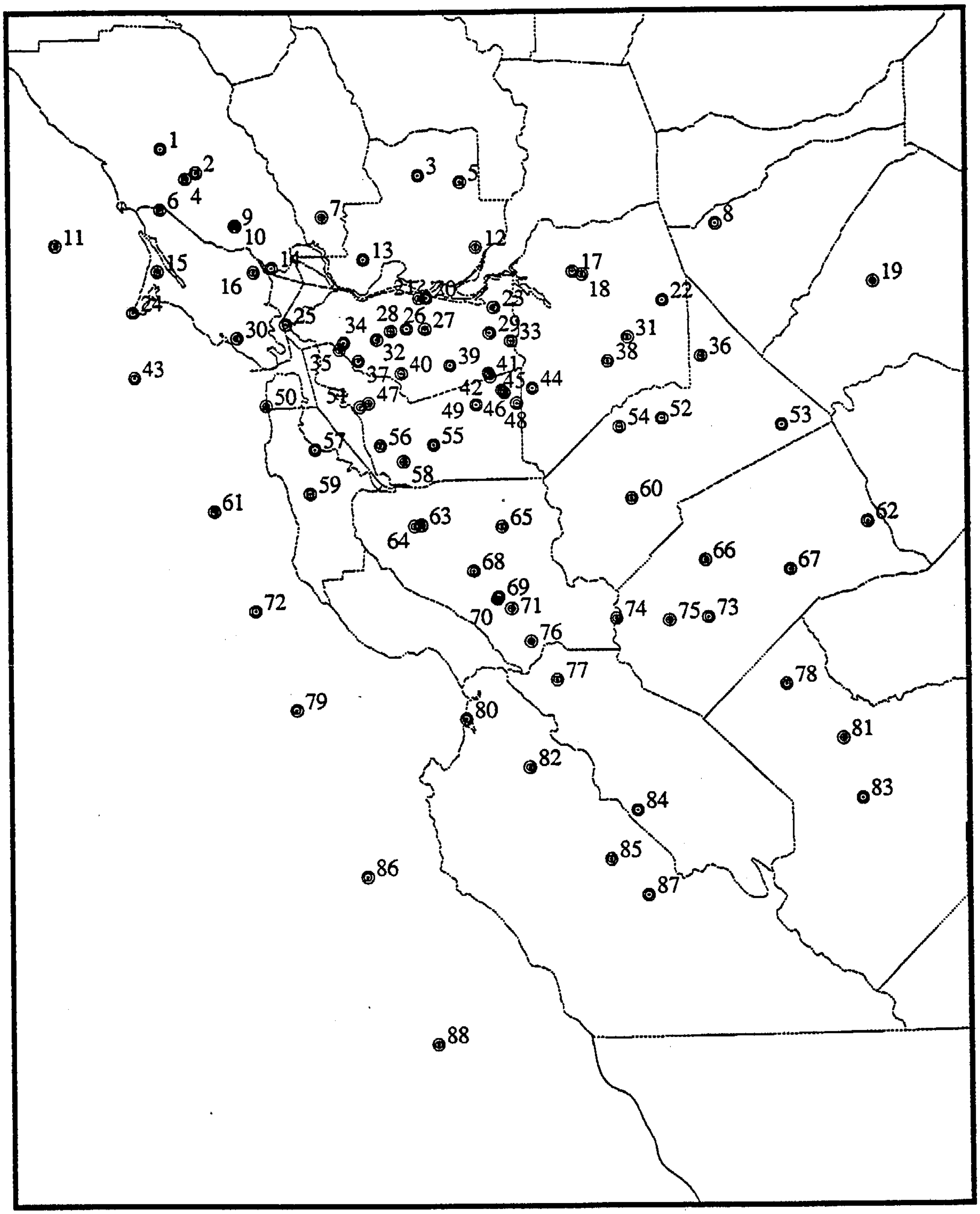


Figure 4-12. Map Showing Surface Wind Sites for North Central Coast Trajectories.

Table 4-2. Wind Sites for North Central Coast Trajectories, Including Site Number (See Figure 4-12) and UTM Coordinates

Page 1 of 2

| No. | UTM-E | UTM-N | Name |
|---|---|---|---|
| 1 | 509326. | 4260012. | MIRABEL |
| 2 | 521048. | 4252113. | SANTA ROSA |
| 3 | 594615. | 4251162. | VACA-DIXON |
| 4 | 517560. | 4250131. | SANTA ROSA |
| 5 | 608447. | 4249024. | DIXON |
| 6 | 509082. | 4239884. | VALLEY FORD |
| 7 | 562970. | 4237474. | NAPA |
| 8 | 692120. | 4234731. | PARDEE RESERVIOR |
| 9 | 533901. | 4234557. | PETALUMA |
| 10 | 534217. | 4234528. | PETALUMA |
| 11 | 473731. | 4227801. | Buoy 13 |
| 12 | 613508. | 4227267. | RIO VISTA |
| 13 | 576467. | 4223319. | S03 |
| 14 | 546108. | 4220470. | SONOMA MARINA |
| 15 | 508034. | 4219265. | POINT REYES NAT. SEASHORE |
| 16 | 540077. | 4219174. | NOVATO |
| 17 | 644999. | 4219043. | LODI |
| 18 | 648134. | 4218112. | STOCKTON LODI |
| 19 | 744224. | 4215090. | MIWUK |
| 20 | 597091. | 4210377. | PITTSBURG POWER PLANT |
| 21 | 594654. | 4210317. | PITTSBURG AQ |
| 22 | 674424. | 4209197. | BELLOTA |
| 23 | 619302. | 4207157. | BETHEL ISLAND |
| 24 | 499780. | 4205454. | POINT REYES-LIGHT HOUSE |
| 25 | 550779. | 4201543. | PT. SAN PABLO |
| 26 | 590551. | 4199976. | CLAYTON |
| 27 | 596655. | 4199860. | KREGOR |
| 28 | 585334. | 4199272. | CONCORD |
| 29 | 617889. | 4198536. | BRENTWOOD |
| 30 | 534546. | 4196927. | MT. TAMALPAIS |
| 31 | 662985. | 4196750. | COLLEGEVILLE |
| 32 | 580724. | 4196420. | WALNUT CREEK |
| 33 | 624745. | 4195770. | BRENTWOOD |
| 34 | 569890. | 4195366. | SOBRANTE |
| 35 | 568518. | 4193012. | VOLLMER PEAK |
| 36 | 687055. | 4190293. | WOODWARD RESERVIOR |
| 37 | 574661. | 4189089. | MORAGA |
| 38 | 656394. | 4188758. | MANTECA |
| 39 | 604892. | 4187601. | HIGHLAND |
| 40 | 588735. | 4185006. | DANVILLE |
| 41 | 617424. | 4184996. | WIND MASTER 1 |
| 42 | 617930. | 4183800. | WIND MASTER 2 |
| 43 | 500142. | 4183439. | Buoy 12A |
| 44 | 631692. | 4179878. | ALTAMONT |
| 45 | 621666. | 4179324. | FLOWWIND |
| 46 | 622537. | 4178319. | SEA WEST |

Table 4-2. Wind Sites for North Central Coast Trajectories, Including Site Number (See Figure 4-12) and UTM Coordinates



| No. | UTM-E | UTM-N | Name |
|---|---|---|---|
| 47 | 577947. | 4175035. | CHABOT |
| 48 | 626484. | 4174772. | TESLA |
| 49 | 613362. | 4174396. | VASCO |
| 50 | 544069. | 4174106. | FT. FUNSTON |
| 51 | 575167. | 4173806. | LEANDRO |
| 52 | 673945. | 4169468. | MODESTO |
| 53 | 713827. | 4167166. | TURLOCK LAKE |
| 54 | 660049. | 4166784. | MODESTO |
| 55 | 599220. | 4161145. | SUNOL |
| 56 | 581760. | 4160862. | UNION CITY |
| 57 | 560212. | 4159568. | SAN MATEO |
| 58 | 589223. | 4155607. | FREMONT |
| 59 | 558549. | 4144918. | MT. PISE |
| 60 | 664023. | 4143058. | SOLADO |
| 61 | 526553. | 4139076. | Buoy 12 |
| 62 | 742018. | 4135146. | MARIPOSA |
| 63 | 595034. | 4134589. | SAN JOSE |
| 64 | 592824. | 4134195. | ALVISO |
| 65 | 621445. | 4134038. | MT. HAMILTON |
| 66 | 688069. | 4122565. | KESTERSON |
| 67 | 716315. | 4119329. | EL NIDO |
| 68 | 612241. | 4119298. | METCALF |
| 69 | 620254. | 4110625. | MORGAN HILL |
| 70 | 619895. | 4109818. | MORGAN HILL |
| 71 | 624409. | 4106678. | SAN MARTIN |
| 72 | 540040. | 4105859. | Buoy 12B |
| 73 | 689041. | 4103408. | NORTH WEST OF ORO LOMA |
| 74 | 658726. | 4103153. | PACHECO PASS-CORRAL |
| 75 | 676136. | 4102450. | LOS BANOS |
| 76 | 630705. | 4095553. | GILROY |
| 77 | 639124. | 4082679. | HOLLISTER |
| 78 | 714847. | 4080862. | FIREBAUGH |
| 79 | 553527. | 4072642. | Buoy 42 |
| 80 | 609454. | 4069640. | CASTROVILLE |
| 81 | 733464. | 4062722. | MENDOTA |
| 82 | 630082. | 4053563. | SALINAS |
| 83 | 739731. | 4042877. | THREE ROCKS |
| 84 | 665223. | 4039123. | PINNACLES NATION. MONUMENT |
| 85 | 656428. | 4022992. | GREENFIELD |
| 86 | 576474. | 4017378. | Buoy 42A |
| 87 | 668581. | 4011073. | KING CITY |
| 88 | 599421. | 3962114. | Buoy 28 |

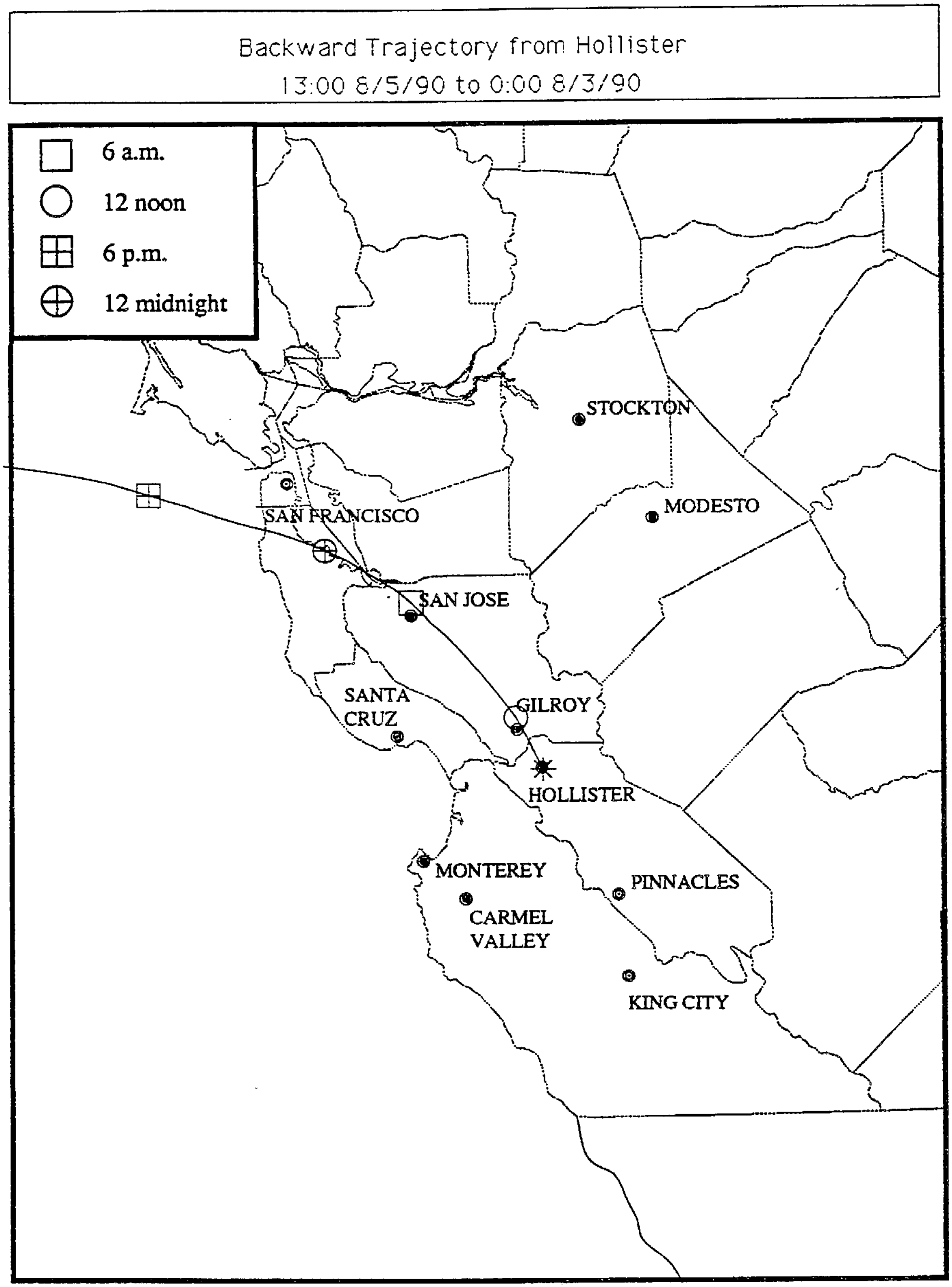


Figure 4-13. Surface Back Trajectory From Hollister on August 5, 1990 Beginning at 1300 PST.



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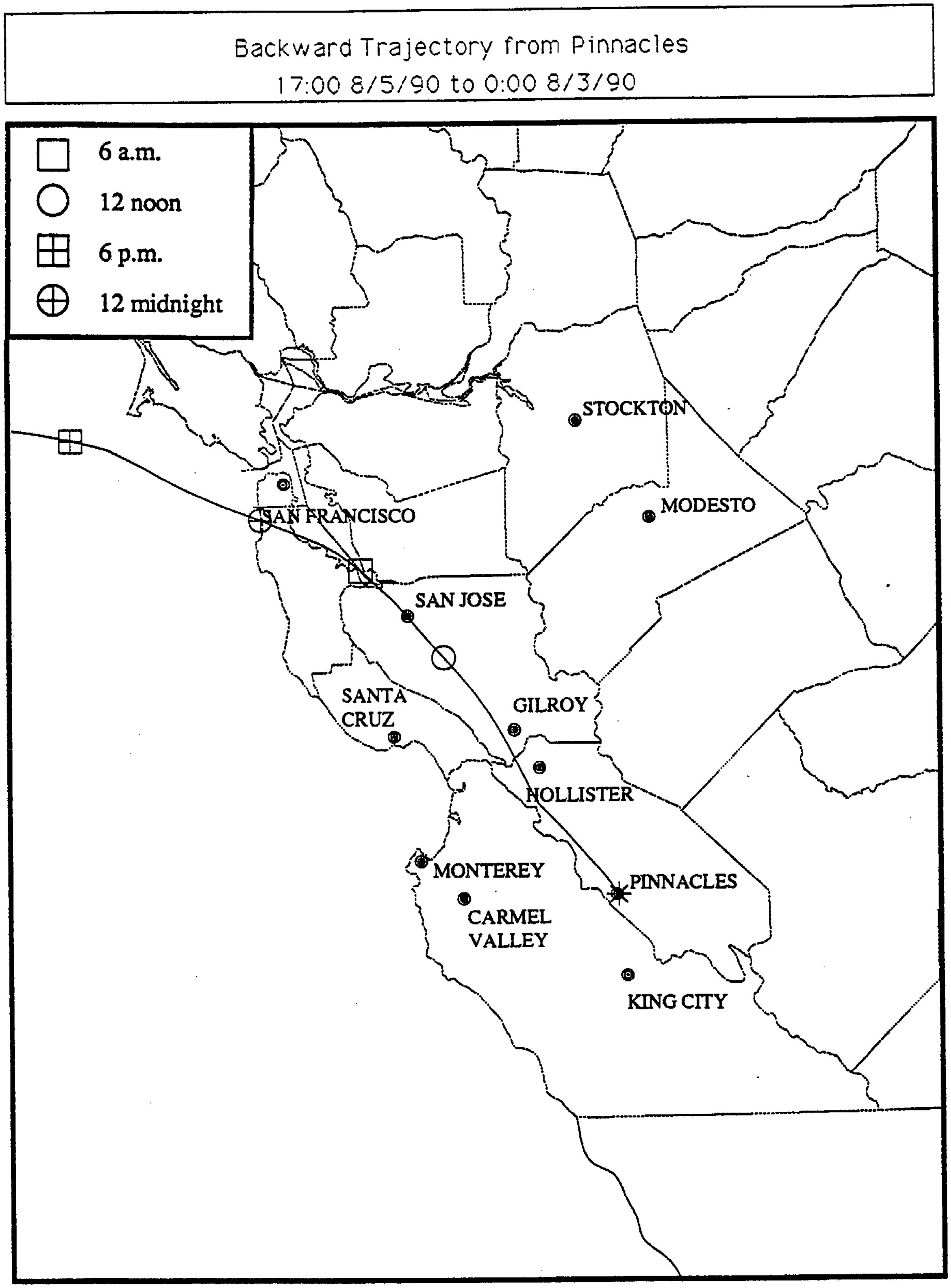


Figure 4-14. Surface Back Trajectory From Pinnacles on August 5, 1990 Beginning at 1700 PST.

Bay/San Jose area during the morning rush-hour. The same is true for the Gilroy back trajectory for 1400 PST (not shown).

Diurnal ozone concentrations for Gilroy, Hollister, and Pinnacles for the August 5-7, 1990 period are shown in Figure 4-15. Peak ozone concentrations on this day were 10 pphm at all three monitoring sites. The diurnal profiles at Gilroy and Hollister are similar with a single peak during the early afternoon. However, note that the ozone peak at Gilroy was later than the ozone peak at Hollister, even though the two sites are very close together and Gilroy is upwind of Hollister. This implies that it was not the same air parcel which produced the peak concentration at each site. This situation is repeated for Gilroy and Hollister on many transport days. A number of issues might contribute to this situation, including the following:

- The closeness of the upwind area and the large area of high emissions density in the upwind area which produce a non-uniform precursor mix;
- The addition of fresh emissions along the transport path which might modify the precursor mix and thus the ozone formed;
- The potential for faster transport aloft with a different mix of surface and aloft transport at the two sites; and
- Potential late-afternoon dilution of air parcels arriving at Hollister caused by westerly flow from Monterey Bay.

The Gilroy peak often being later than the Hollister peak illustrates why we had a difficult time using the timing of peak concentrations as an indicator of transport (see Section 2.2.4).

At Pinnacles, there is often a peak about noon and a later peak about 1600-2000 PST (see Figure 4-15). Note that the Pinnacles data are labeled as suspect; the station operator noted some irregular readings on the chart recorder during the August 1-9 period. However, the general characteristics of the diurnal ozone profiles during these days are consistent with the characteristics on other days, and no obvious or abrupt change in ozone concentration is evident. Therefore, we have used these data, but labeled it as suspect. This was necessary since this is one of the few periods with high ozone concentrations in the NCC and with sufficient wind data to perform trajectory analyses.

Figure 4-16 shows the diurnal ozone concentrations for Gilroy, Hollister, and Pinnacles for the July 10-12, 1990 period. On July 10, a maximum ozone concentration of 12 pphm was measured at Gilroy at 1300 PST; a back trajectory for this time is shown in Figure 4-17. Note again that the arriving air parcel had been in the South Bay/San Jose area that morning. The back trajectory from Gilroy for the July 11 peak ozone concentrations is similar to Figure 4-17. However, the back trajectories from Hollister for July 10 and 11 are quite different (see Figure 4-18, for example). The Hollister air parcels had been in the Hollister area for a number of hours and had arrived earlier from the west. Ozone and precursor carryover is possible. The convergence zone was present on these days.

Surface back trajectories from Pinnacles for July 10-11, 1990 indicate that air parcels were arriving from the northwest and west via the NCC at 1100, 1700, and 1800 PST on July 10 and at 1000, 1200, and 1600 PST on July 11 (see Figures 4-19, 4-20, and 4-21, for example). However, note that the

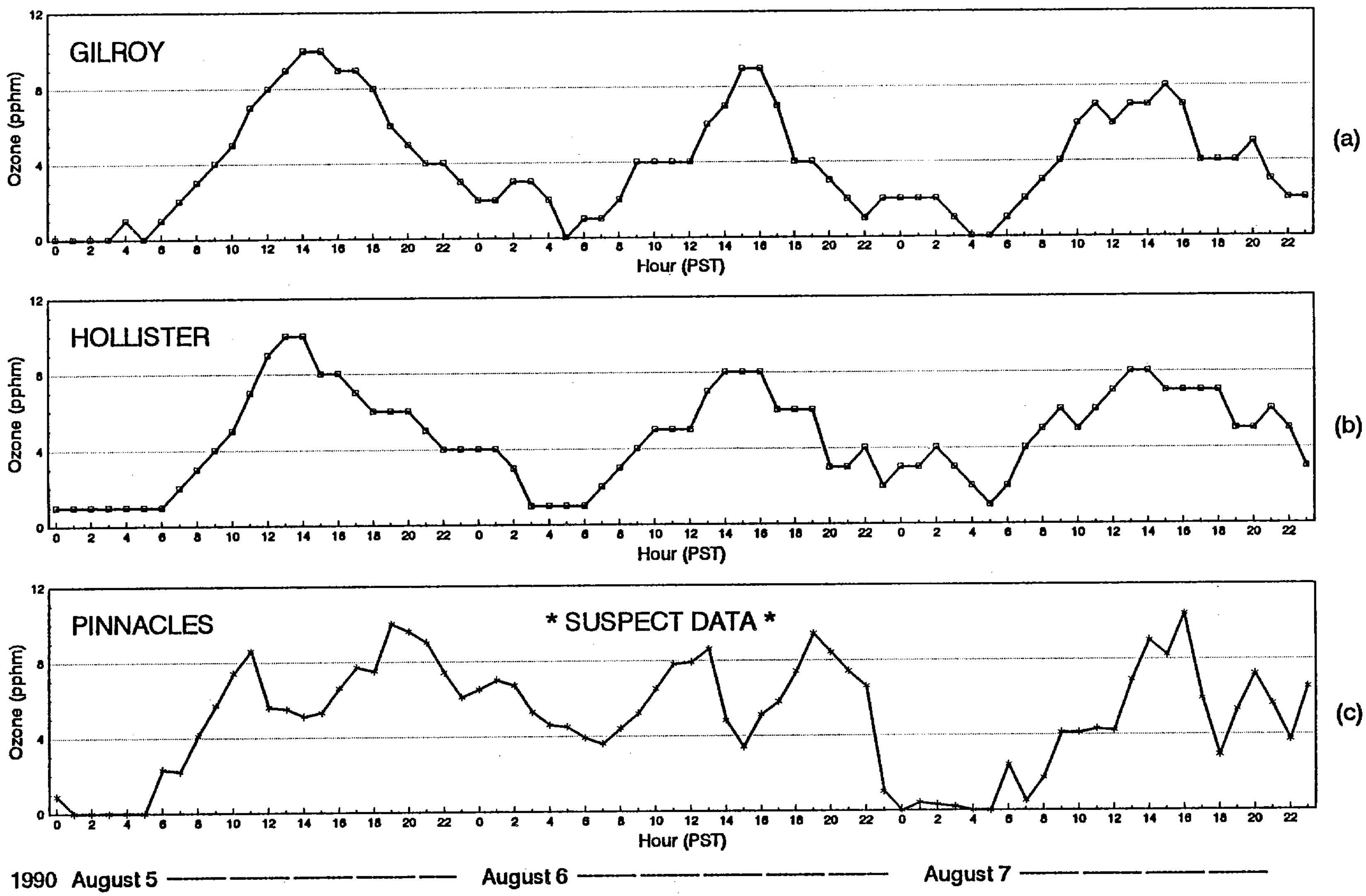


Figure 4-15. Ozone Concentrations Measured at Gilroy, Hollister, and Pinnacles on August 5-7, 1990. Note that the ozone data for the Pinnacles monitor is suspect.

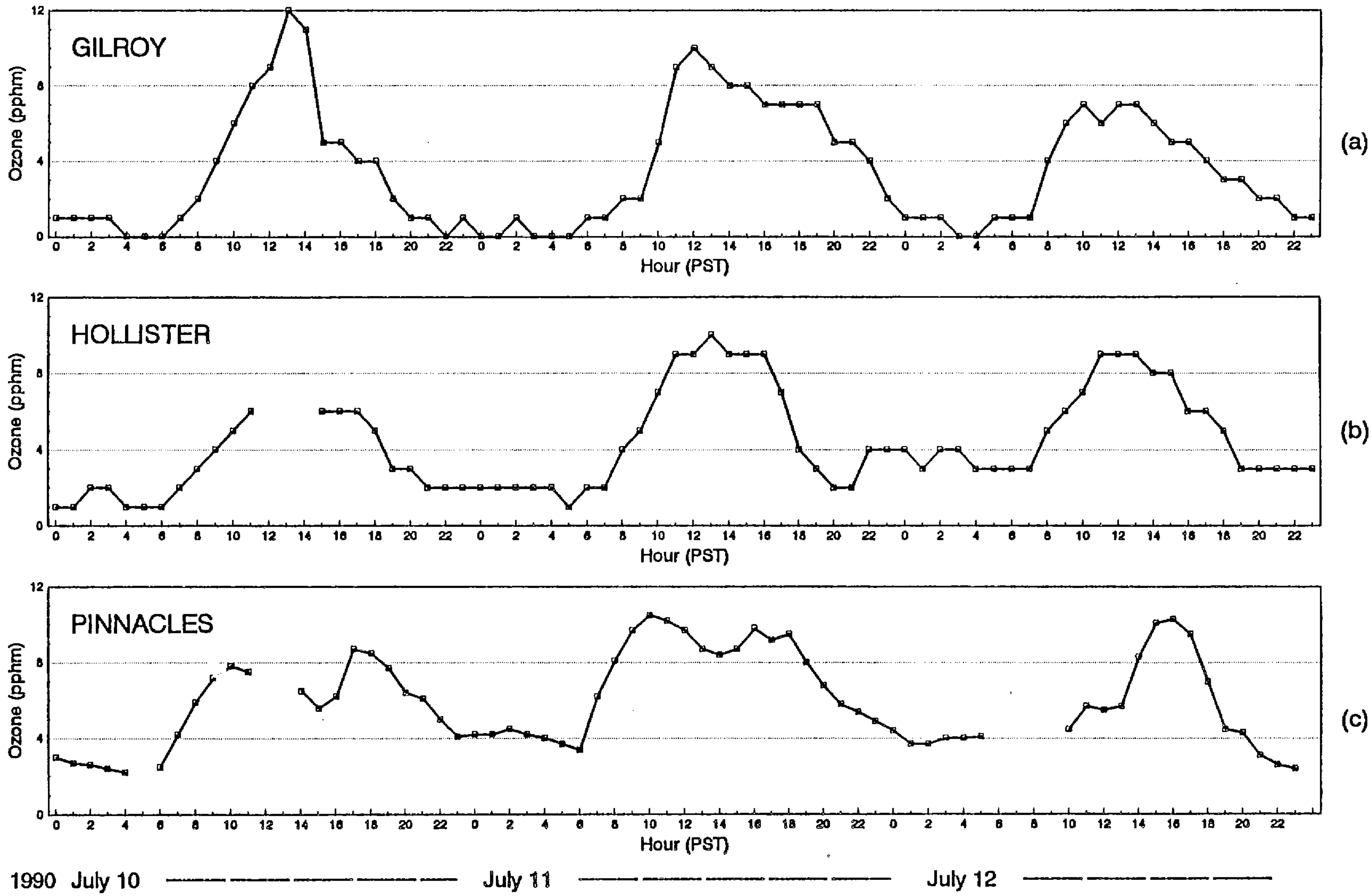


Figure 4-16. Ozone Concentrations Measured at Gilroy, Hollister, and Pinnacles on July 10-12, 1990.

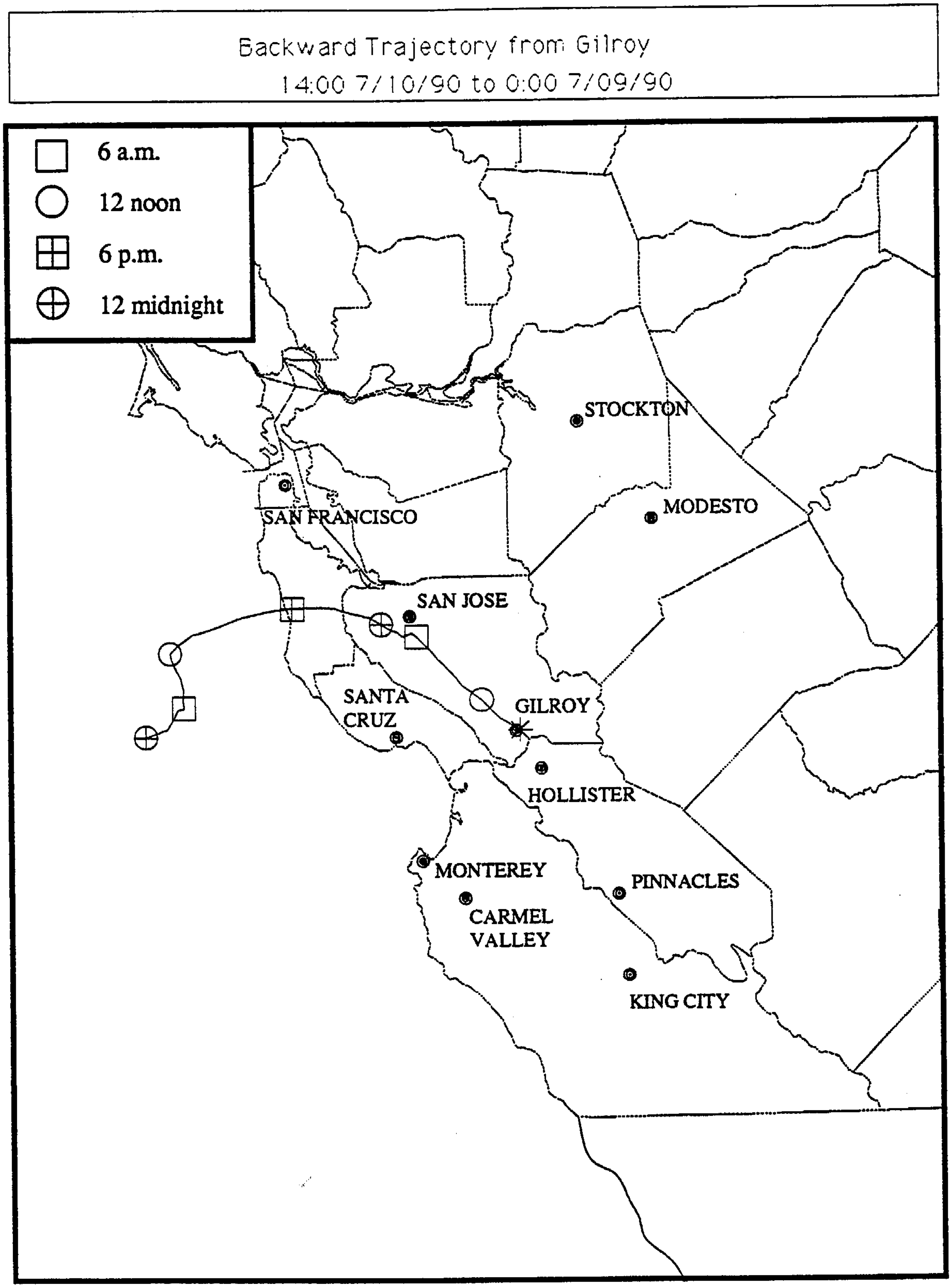


Figure 4-17. Surface Back Trajectory From Gilroy on July 10, 1990 Beginning at 1400 PST.

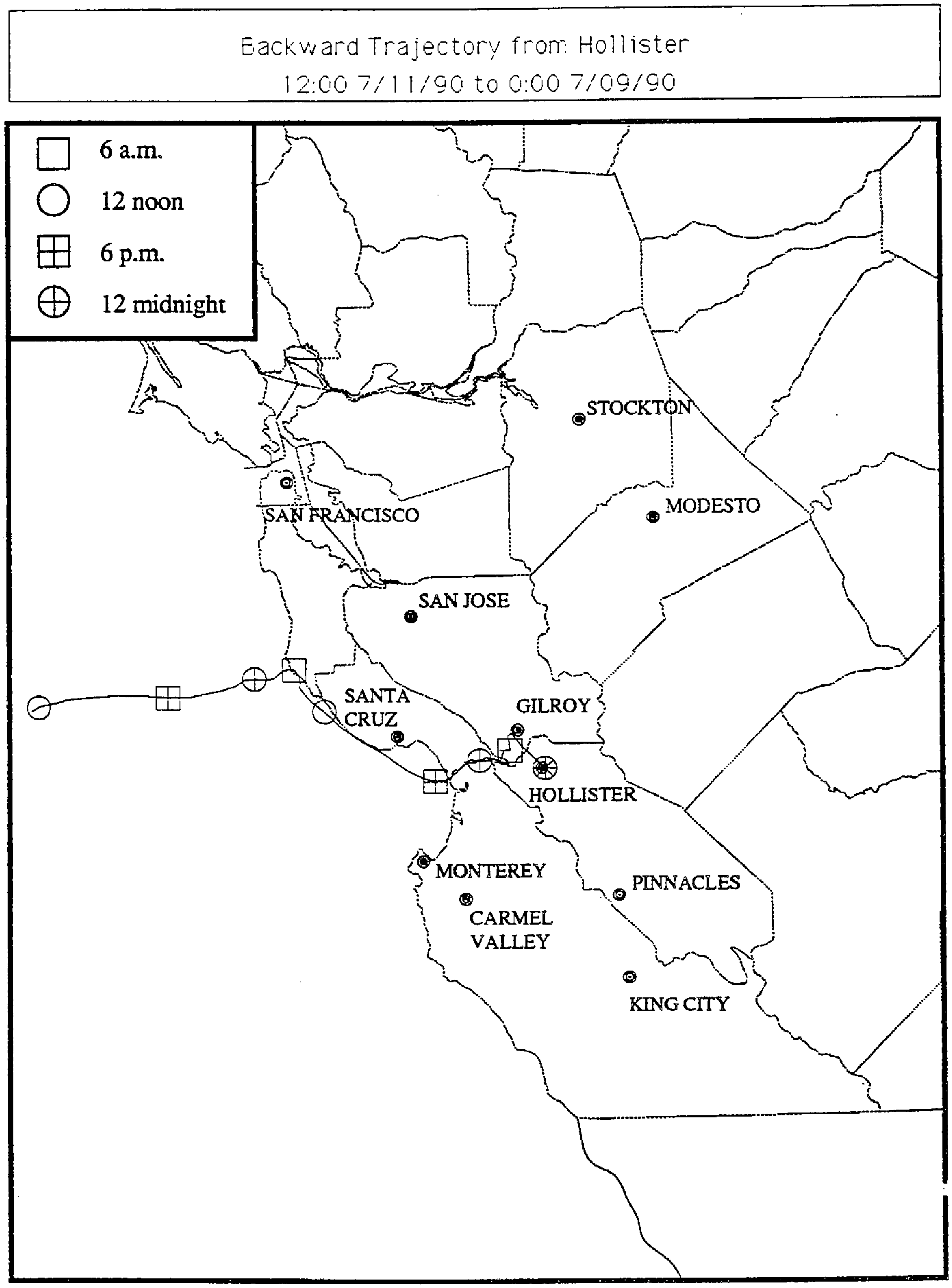


Figure 4-18. Surface Back Trajectory From Hollister on July 11, 1990 Beginning at 1200 PST.

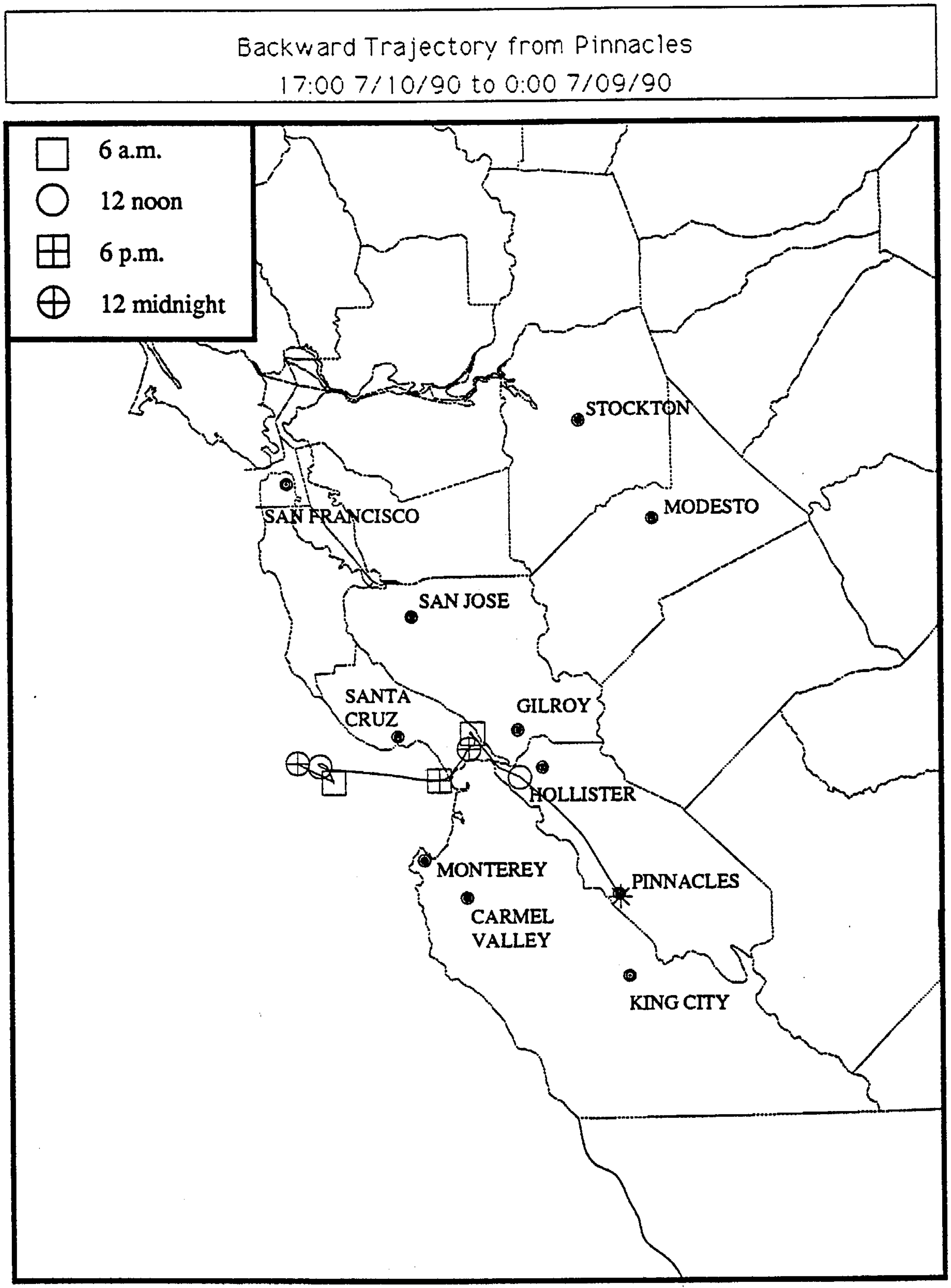


Figure 4-19. Surface Back Trajectory From Pinnacles on July 10, 1990 Beginning at 1700 PST.

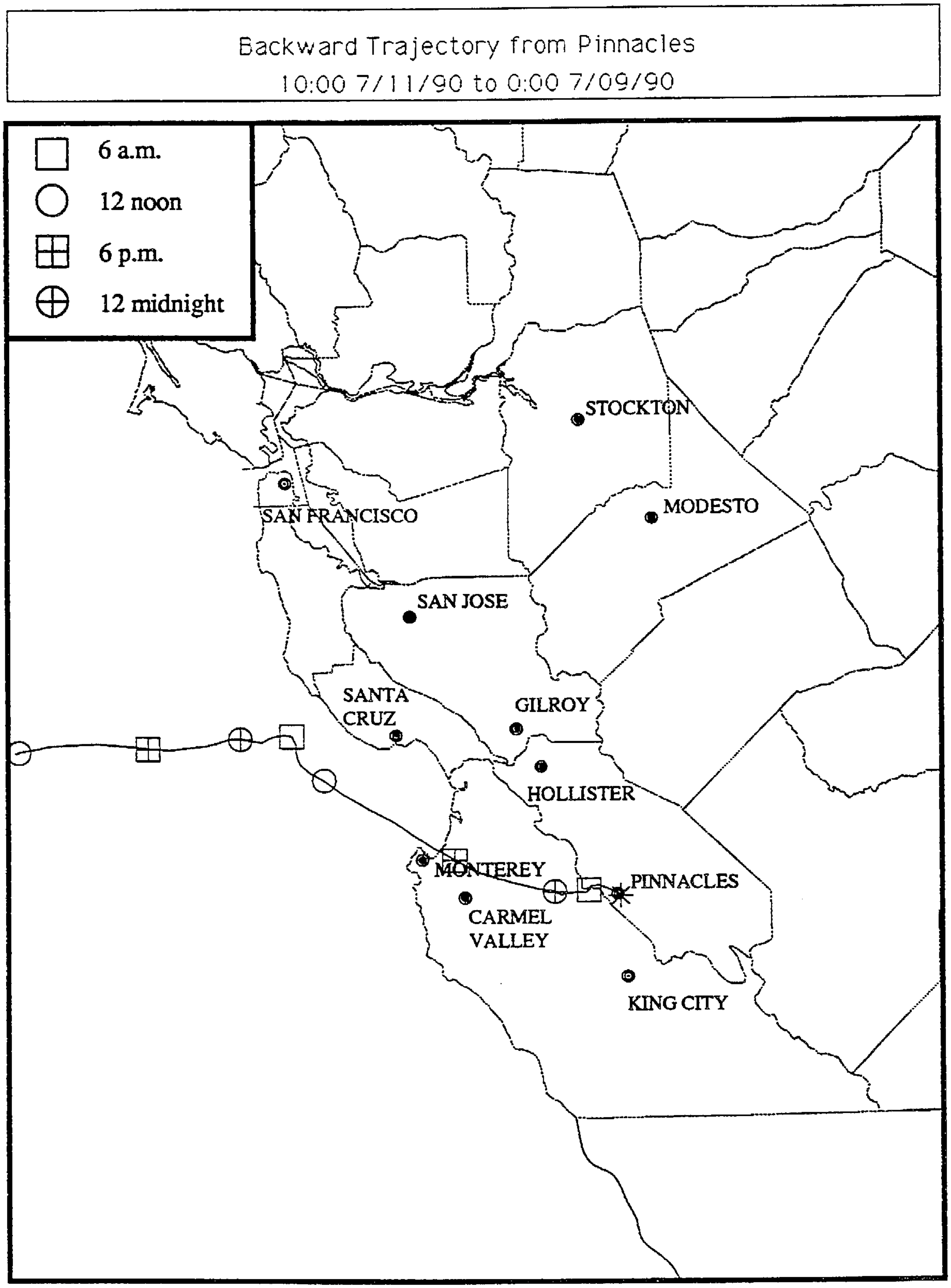


Figure 4-20. Surface Back Trajectory From Pinnacles on July 11, 1990 Beginning at 1000 PST.

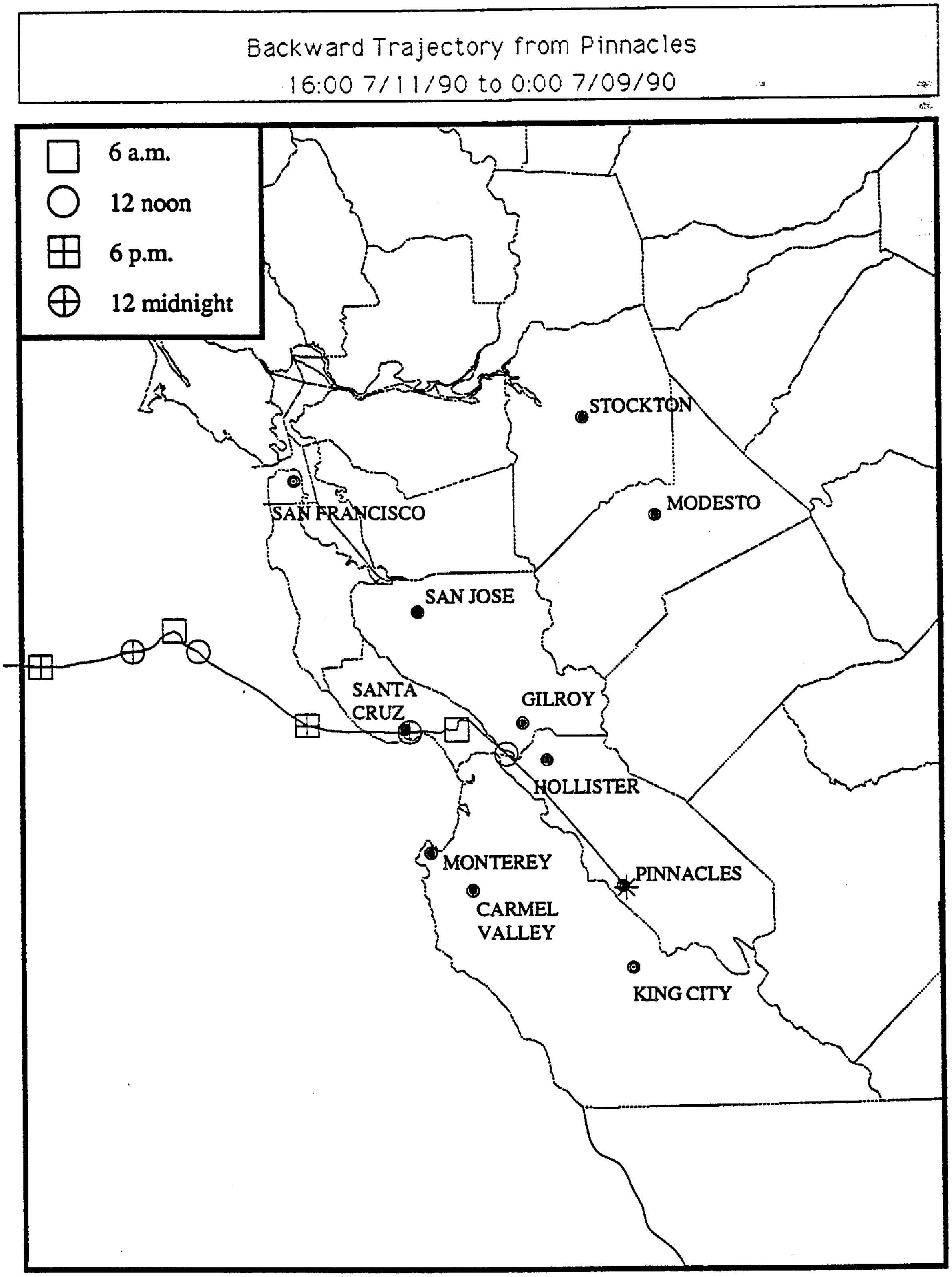


Figure 4-21. Surface Back Trajectory From Pinnacles on July 11, 1990 Beginning at 1600 PST.



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trajectory for the early morning ozone peak (Figure 4-20) arrived across a ridge of the coastal mountains; this seems unlikely. We formulated the wind field model with a barrier along this ridge, but trajectory paths are allowed across the barrier. It is possible that the early ozone peak (1000 PST on July 10 and 11) is the result of mixing down of ozone from aloft which might have been transported into the Pinnacles area overnight, or the result of overnight transport aloft arriving at the high elevation of the Pinnacles monitoring site. In the former case, it is difficult to achieve the observed gradual increase in ozone concentration beginning at 0600 PST. Without aloft meteorological data, we cannot document the mechanism which produces this very early peak at Pinnacles.

At 1800 PST on July 11, 1990 and again at 1500 and 1600 PST on July 12, 1990, surface back trajectories from Pinnacles indicate that air parcels were arriving from the South Bay/San Jose area. These trajectories are similar to the one shown in Figure 4-14.

The Pinnacles monitoring site is located in a small side canyon several kilometers west of the San Benito River valley. We were concerned that back trajectories from the Pinnacles monitoring location might not properly represent arriving air parcels, especially if there were high gradients in wind direction in the Hollister/Gilroy area. We prepared back trajectories from a location 10 km east of the Pinnacles monitoring site and compared the results to the trajectories prepared from the Pinnacles site. There were only minor differences in the timing and pathways of the two sets of trajectories.

Since 1980, high ozone concentrations have occasionally been measured at the Carmel Valley monitoring site (see Section 4.1). However, the highest concentration measured at Carmel Valley during 1990 (when an acceptable set of wind data was available) was the 9 pphm measured on July 11, 1990. Figure 4-22 shows the surface trajectory for this period. The trajectory indicates arriving air parcels had been in the NCC earlier that day and on the previous day. Although one might expect transport along the coast from offshore San Francisco, the wind data from offshore buoys did not show this as likely.

## 4.3 POTENTIAL TRANSPORT ALOFT FROM THE SAN FRANCISCO BAY AREA TO THE NORTH CENTRAL COAST

A major question remains regarding potential transport aloft from the SFBAAB to NCC monitoring sites, including Pinnacles. Because aloft meteorological data were not available in time to use for this project, we were not able to estimate aloft trajectories. However, some aloft air quality data is available which can provide some insight into potential transport aloft. The following discussion uses aloft air quality and meteorological data collected by aircraft during the summer of 1990 (Anderson, 1991).

Past transport studies (Roberts and Main, 1989; Blumenthal, et al., 1974; Blumenthal, et al., 1985; and Blumenthal, et al., 1986, for example) have indicated a significant non-uniform distribution of ozone and ozone precursors aloft, including within the mixed layer. High uncertainty in

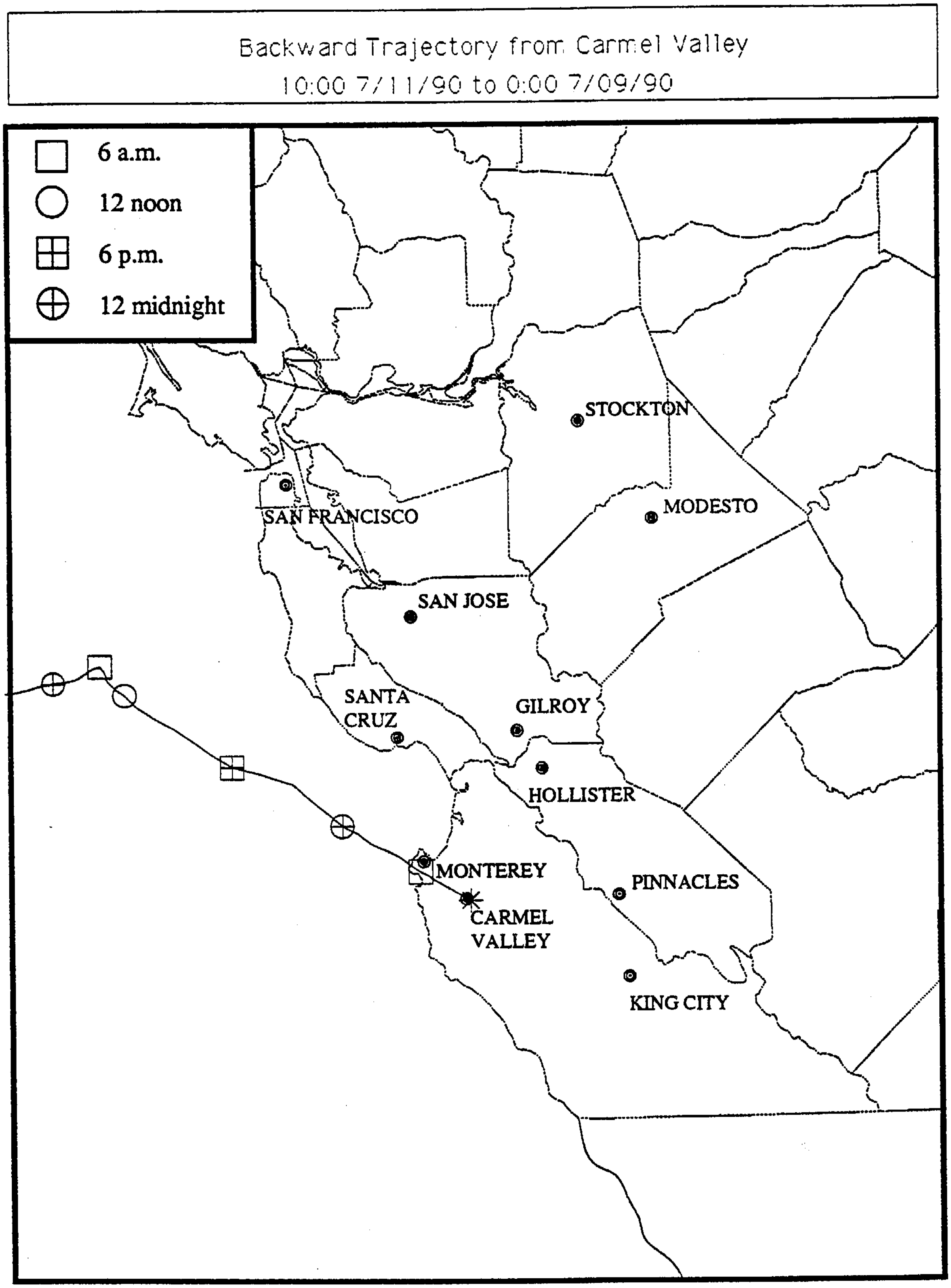


Figure 4-22. Surface Back Trajectory From Carmel Valley on July 11, 1990 Beginning at 1000 PST.



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pollutant flux estimates and transport assessments would have resulted if pollutant concentrations in the mixed layer had been assumed to be constant.

Pollutant transport on August 5, 1990 using surface trajectories was discussed in Section 4.2. Figure 4-14 showed that air parcels arriving at Pinnacles at about 1700 PST on August 5, 1990 had probably been transported along a path from the San Jose area past Gilroy and Hollister to the Pinnacles area. There is no indication of a convergence zone in the Gilroy area on this day.

Figure 4-23 shows an example of aloft air quality and meteorological measurements along this transport path on the afternoon of August 5, 1990. The aircraft performed a spiral from about 5000 feet to near the surface at South County Airport near Morgan Hill. The figure includes two plots, one with ozone, NO, $NO_x$, and temperature as a function of altitude, and another with temperature, dew point, turbulence, and $b_{scat}$ as a function of altitude. Note the following:

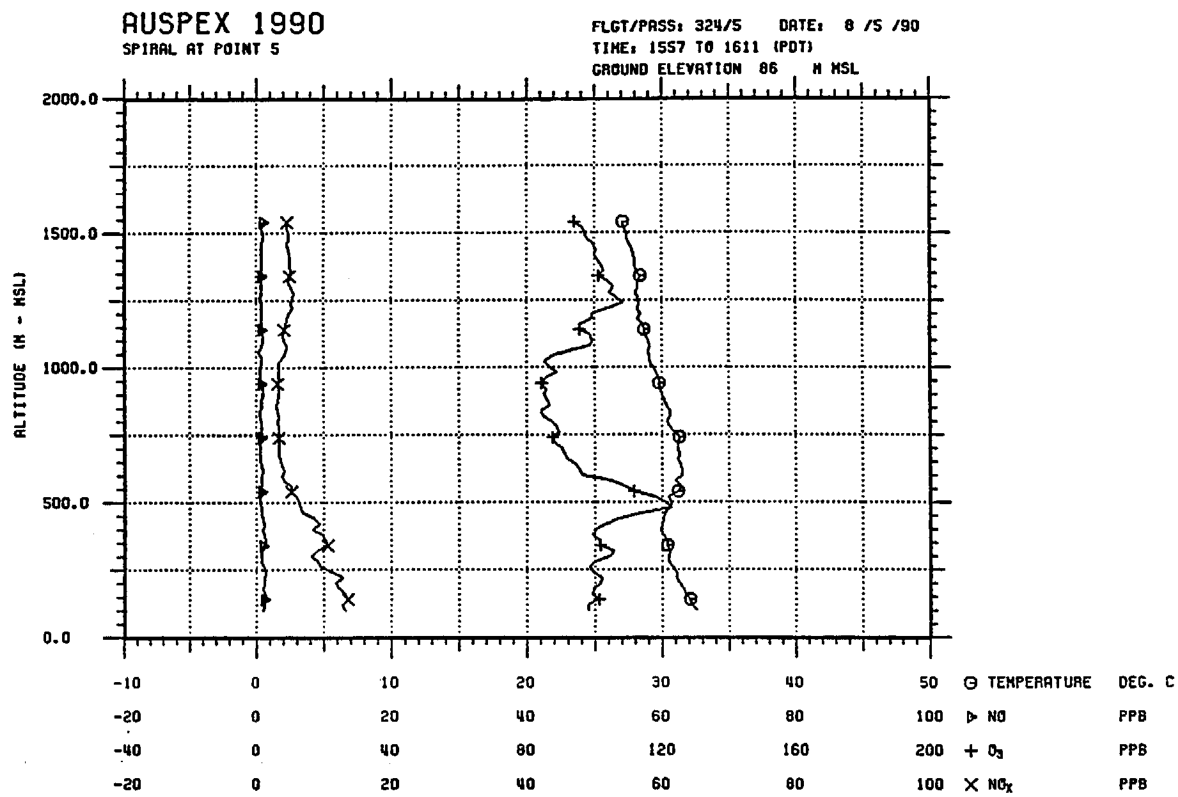
- There is a temperature inversion at about 500 meters;
- The ozone concentration is fairly uniform (about 100 ppb) from the surface up to about 400 meters;
- There is a layer of higher ozone concentrations near the inversion (from about 400-600 meters) with an maximum ozone concentration of about 120 ppb;
- At higher altitudes, the ozone concentrations drop to about 85 ppb between 750 and 1000 meters and then increase again to about the 100 ppb level above 1000 meters; and
- $NO_x$ concentrations are highest near the surface and decrease below 5 ppb above the inversion at about 500 meters.

On this day, consistent northwesterly flow at the surface along the Santa Clara Valley carried pollutants past Gilroy and Hollister and on to Pinnacles (see Figure 4-14). Peak ozone concentrations were 10 pphm at all three monitoring sites (see Figure 4-15), consistent with the aircraft measurements near the surface.

However, the aloft air quality measurements show different characteristics on the afternoon of August 4, 1990 (see Figure 4-24). Note the following:

- The temperature inversion is at an altitude of about 900 meters;
- The 300 meter-thick layer of ozone with a maximum of about 170 ppb just below the inversion;
- The non-uniform distribution of both ozone and $NO_x$;
- The variable structure of the 'mixed layer', as evidenced by the temperature, dewpoint, and turbulence; and
- The variable turbulence data suggests a number of layers of wind shear which probably contribute to the multiple layers of pollutants.

On this day, a convergence zone existed near Gilroy which restricted surface flow along the Santa Clara Valley. Peak ozone concentrations were 7, 5, and 9 pphm at Gilroy, Hollister, and Pinnacles, respectively, lower than on



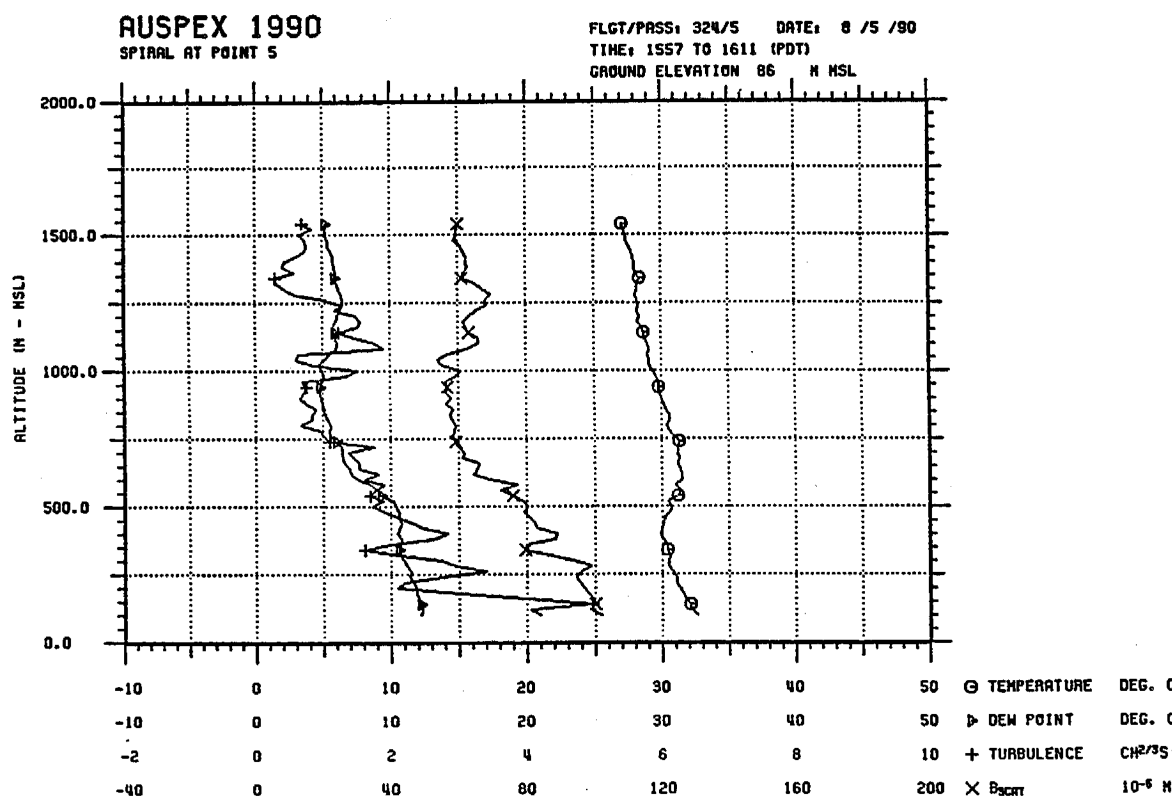
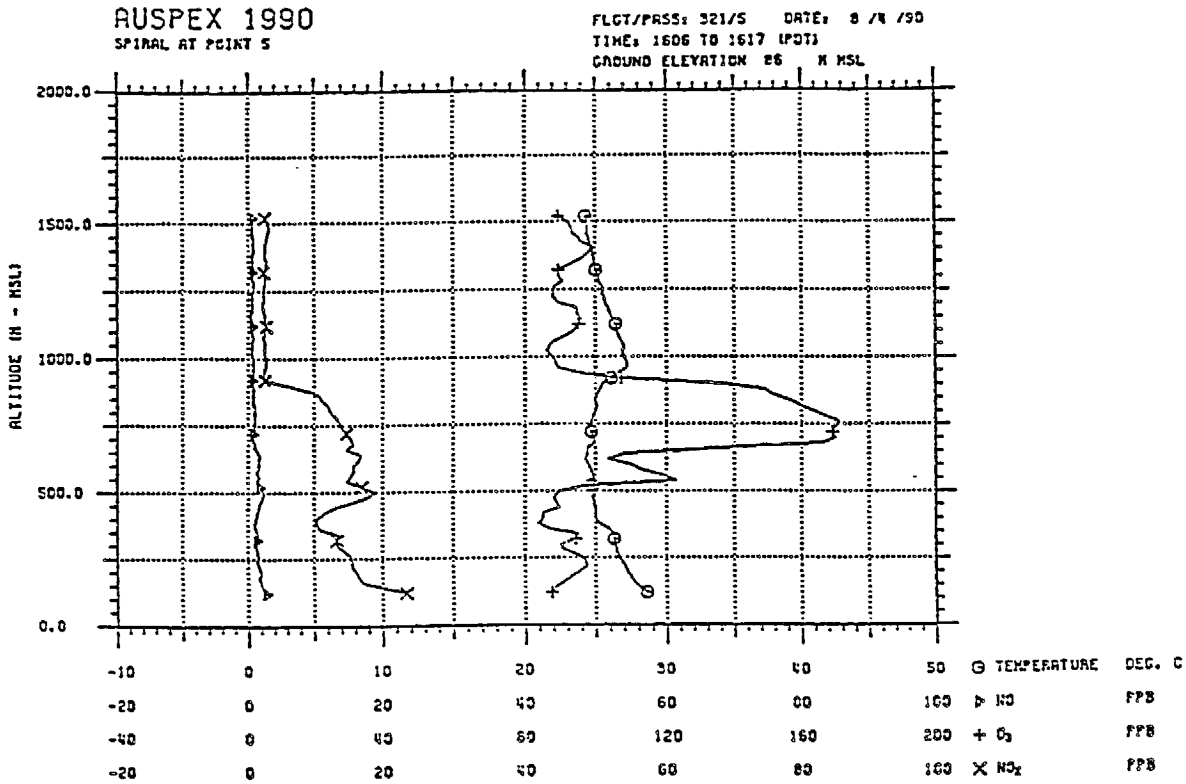




Figure 4-23. Air Quality and Meteorological Data Over South County Airport (Between Morgan Hill and Gilroy) on the Afternoon of August 5, 1990. From Anderson, et al., 1991.



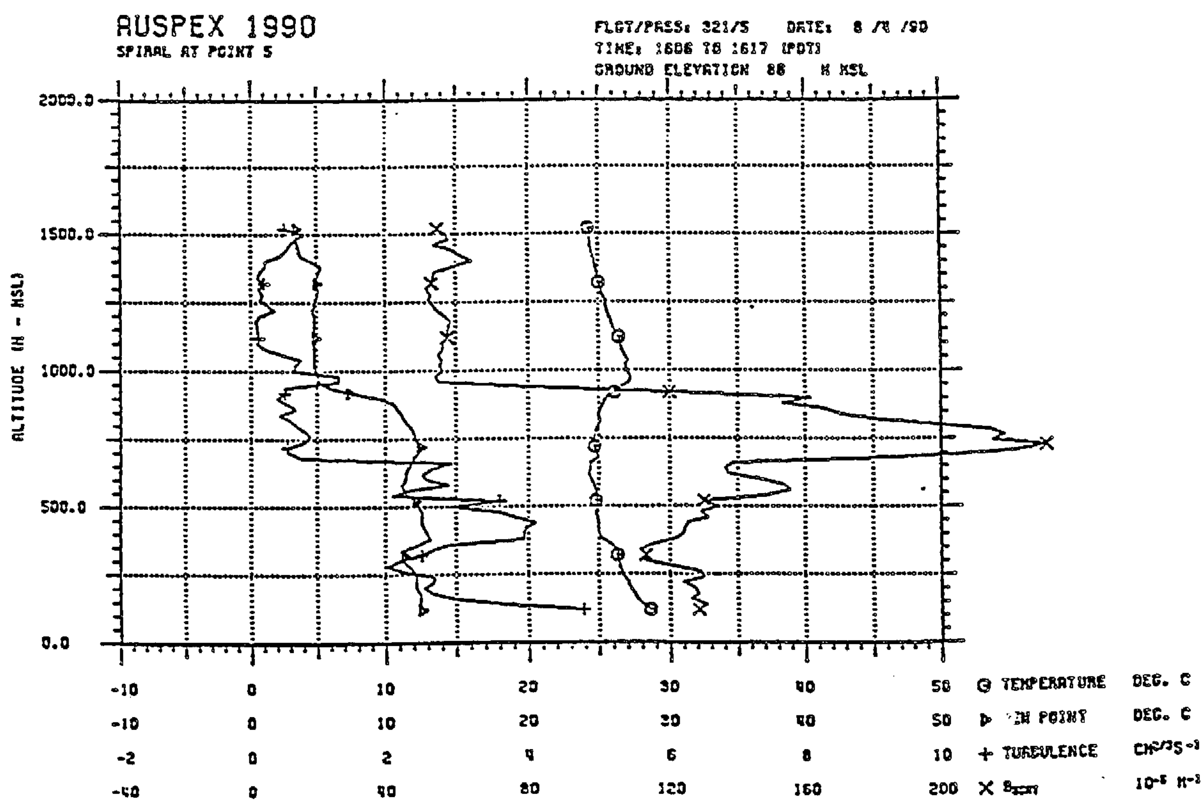




Figure 4-24. Air Quality and Meteorological Data Over South County Airport (Between Morgan Hill and Gilroy) on the Afternoon of August 4, 1990. From Anderson, et al., 1991.

August 5. If the aloft winds had carried the 170 ppb ozone layer southeast to Pinnacles, then higher concentrations would have been expected there. This indicates that pollutant transport probably did not occur aloft on this day. When the aloft wind data from Morgan Hill and Hollister are available, the interpretation of the transport processes on these two days should be greatly improved.

## 4.4 PRECURSOR CONTRIBUTION ESTIMATES

This section presents precursor contribution estimates at North Central Coast Air Basin monitoring sites and at Gilroy for high ozone concentration days during 1990. Summaries are presented for both transport and local days, as defined by the surface trajectory paths, for Gilroy, Hollister, Pinnacles, and Carmel Valley. The methods used and the assumptions made were discussed in Section 2.4. All of these results are based on surface trajectories, since aloft data was not yet available when this report was prepared.

Most Gilroy back trajectories indicated transport from the South Bay/San Jose area. Thus, over 90 percent of the precursors arriving at Gilroy were from the SFBAAB (see Figure 4-25b). A small contribution from NCC sources is due to the wide box which accumulates emissions and the small distance between Gilroy and the boundary of the North Central Coast Air Basin.

One Gilroy trajectory indicated that arriving air parcels came from the west. For this case, Figure 4-25a shows that the precursor contributions from the NCC and the SFBAAB were about equal.

The precursor contribution estimates for Hollister are very similar to those for Gilroy. Figure 4-26b shows that on transport days, the SFBAAB contributes more than 90 percent of the precursor emissions of both $NO_x$ and ROG to arriving air parcels. Again, contributions are about equally split between the NCC and the SFBAAB on local days (see Figure 4-26a).

Figure 4-27 shows the local and transport precursor contribution estimates for Pinnacles. Early-arriving local trajectories show all contributions from the North Central Coast Air Basin. However, late-arriving trajectories pass close to the boundary of the NCC and the SFBAAB (see Figure 4-19) and thus include a small contribution from the SFBAAB. For transport trajectories, the NCC contributes an average of about 20 percent of both $NO_x$ and ROG, while the SFBAAB contributes about 80 percent. This result shows that even if there is direct transport from an upwind air basin, the downwind air basin still contributes some precursors to arriving air parcels.

Figure 4-28 shows the local and transport precursor contribution estimates for East Pinnacles, the trajectories we prepared to test the sensitivity of the results to the starting location. The results for East Pinnacles are almost identical to those for Pinnacles (see Figure 4-27).

Since the Carmel Valley trajectories for July 11, 1990 did not enter any other air basin, all precursors are estimated to be contributed by the North Central Coast Air Basin.

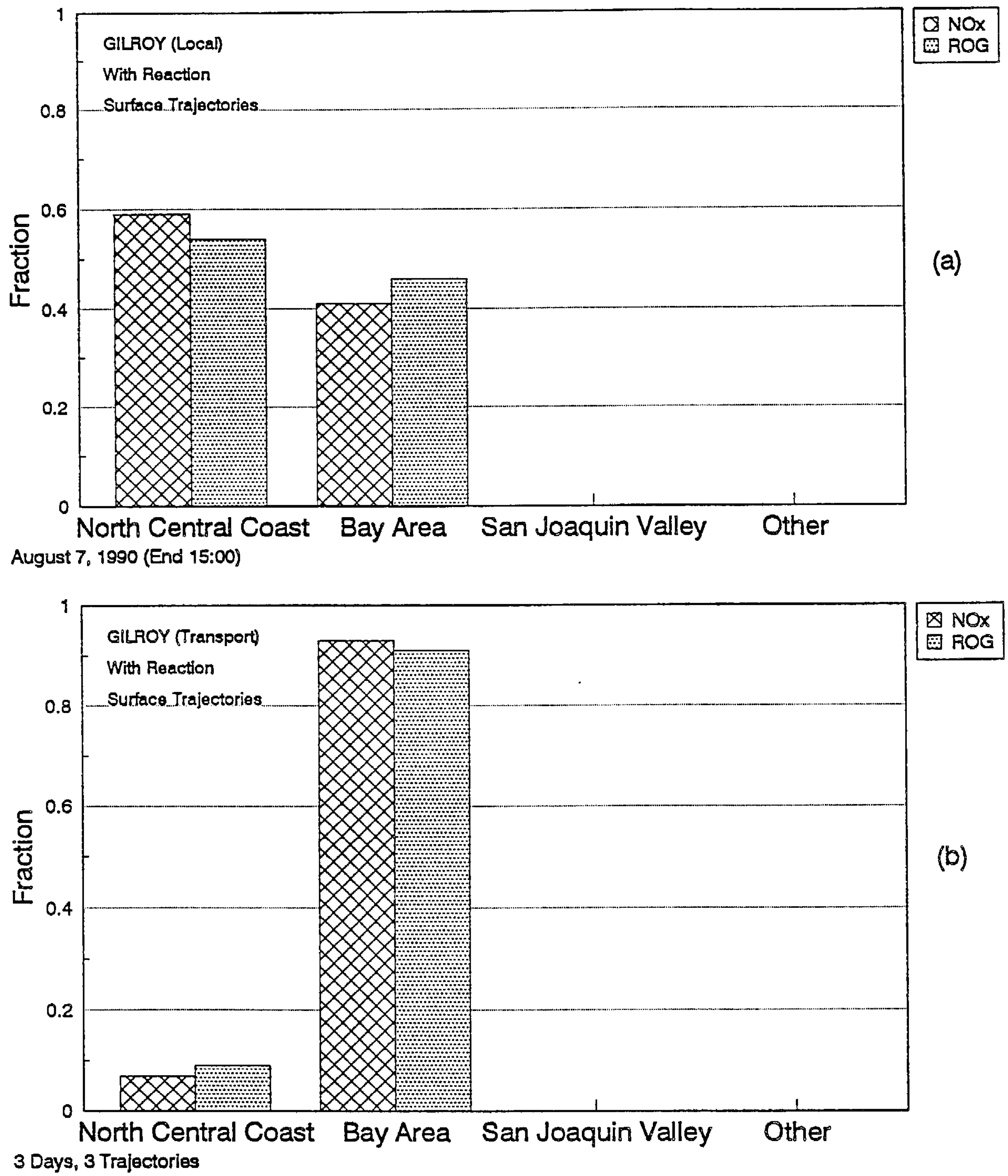



Figure 4-25. Average Precursor Contribution Estimates for Local (a) and Transport (b) High-Ozone Days During 1990 at Gilroy Using Surface Trajectories.

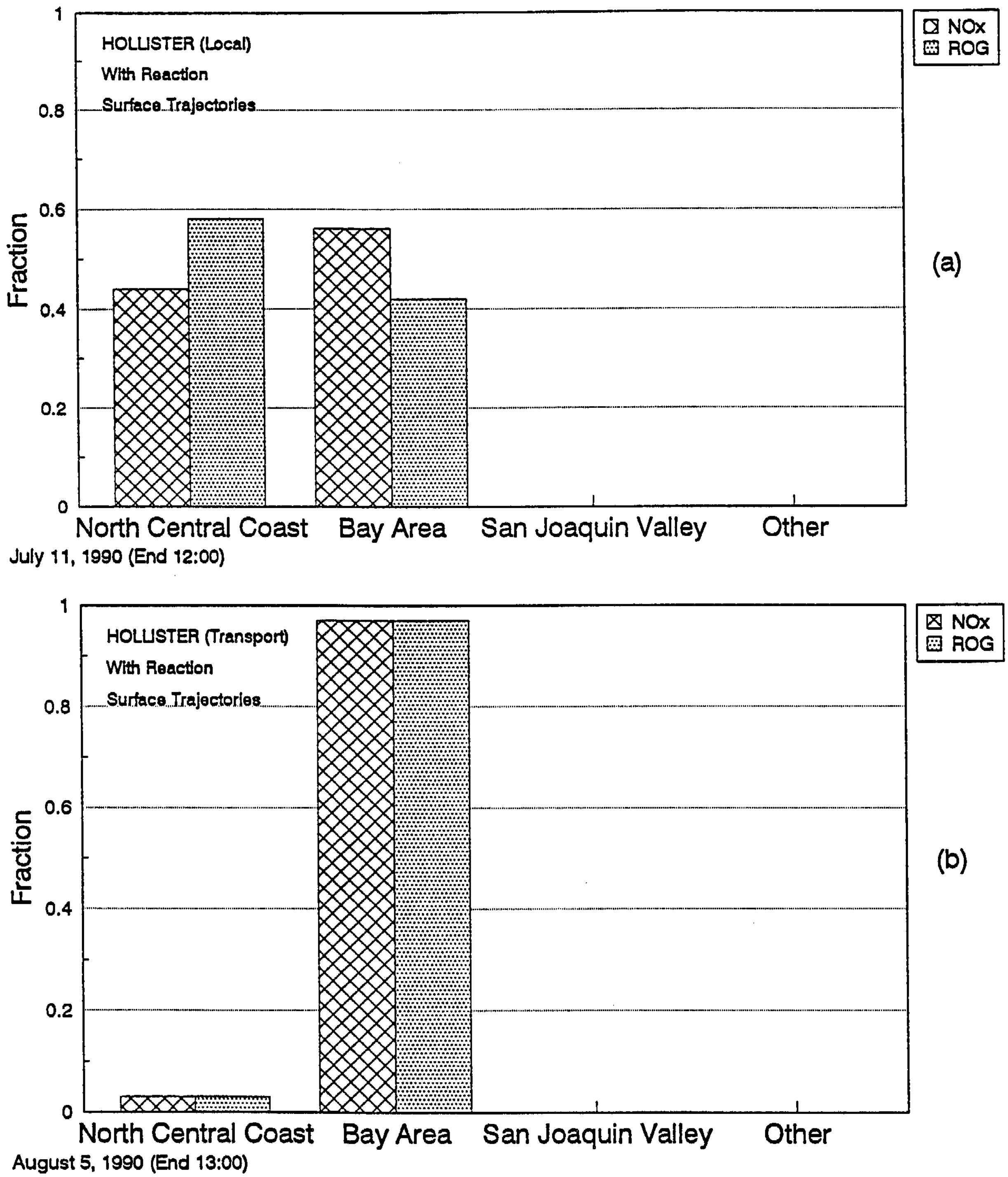



Figure 4-26. Typical Precursor Contribution Estimates for Local (a) and Transport (b) Days at Hollister Using Surface Trajectories.

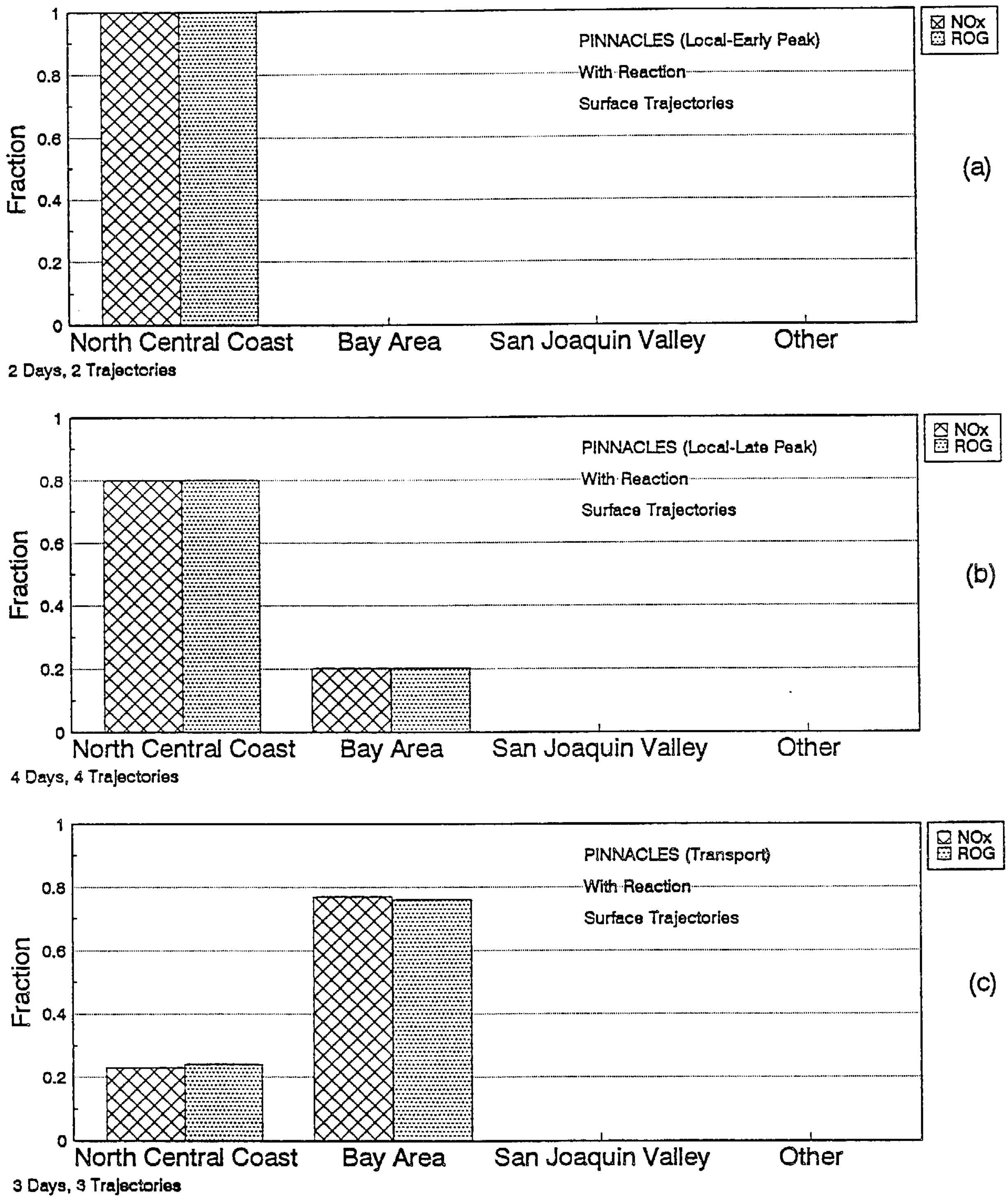



Figure 4-27. Average Precursor Contribution Estimates for Local-Early Peak (a), Local-Late Peak (b), and Transport (c) High-Ozone Days During 1990 at Pinnacles Using Surface Trajectories.

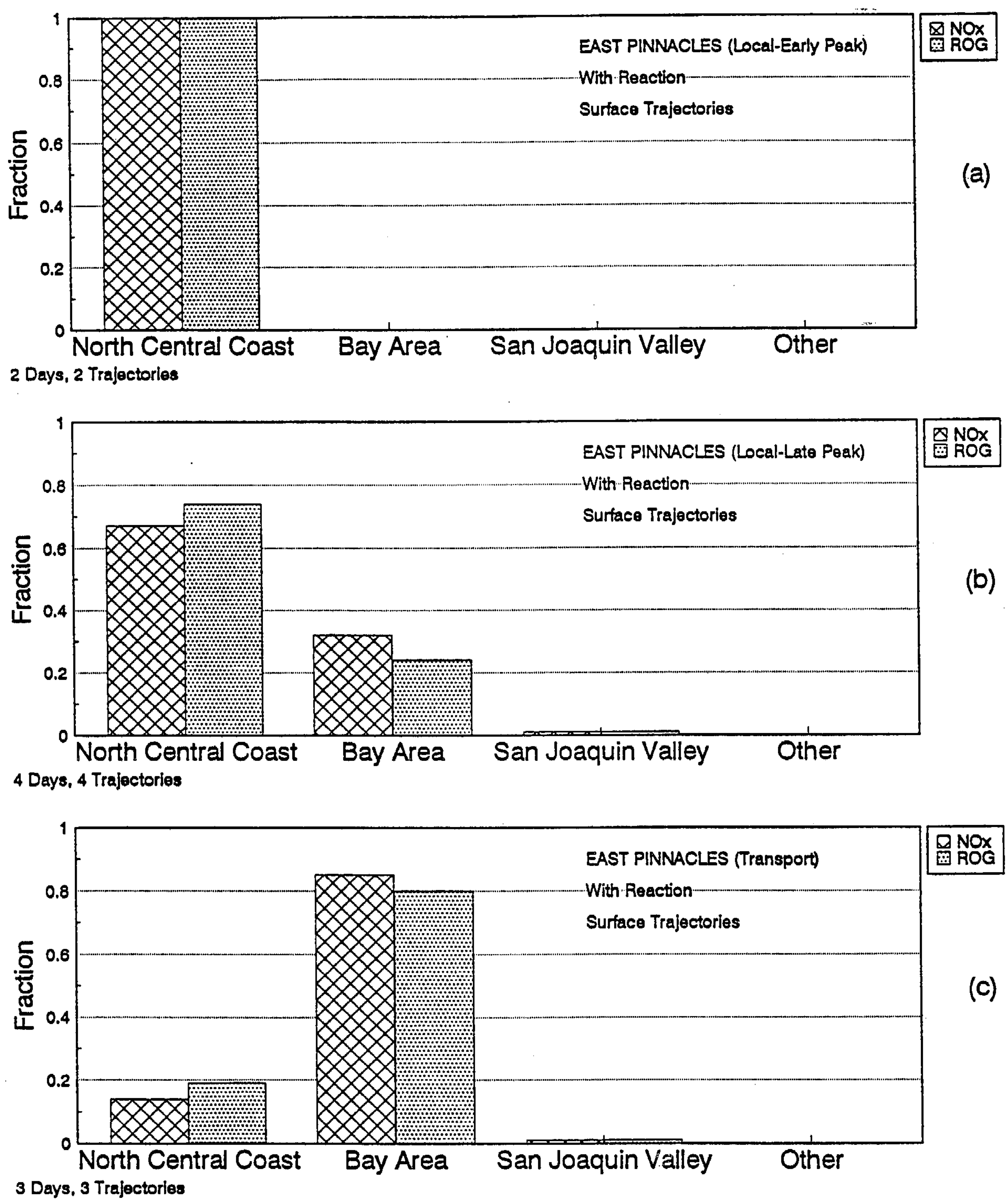



Figure 4-28. Average Precursor Contribution Estimates for Local-Early Peak (a), Local-Late Peak (b), and Transport (c) High-Ozone Days During 1990 at East Pinnacles Using Surface Trajectories.

# 5. TRANSPORT TO THE SOUTHEAST DESERT AIR BASIN (SAN BERNARDINO COUNTY PORTION) AND LOCAL CONTRIBUTIONS TO OZONE VIOLATIONS

Air quality in the Mojave Desert is frequently affected by the transport of pollutants from the South Coast Air Basin (SoCAB) and from the San Joaquin Valley (SJV). The principal transport routes from the SoCAB are Soledad Canyon and Cajon Pass. Flow through Banning Pass transports material into the Twentynine Palms area. Flow over the Tehachapi Mountains carries material from the San Joaquin Valley into the western part of the Mojave Desert. All of these routes have been identified in past studies. In this section we discuss the frequency and characteristics of transport along these routes and identify exceedances in the Mojave Desert which are not associated with such transport.

The primary locations where ozone is monitored in the Mojave Desert are Barstow, Trona, Victorville, Hesperia, Phelan, and Twentynine Palms. Hourly weather data are available for Lancaster, Edwards AFB, China Lake, Daggett, and George AFB. A map of the area is shown as Figure 5-1.

## 5.1 BACKGROUND

Several studies have documented the transport of pollutants from the SoCAB and the SJV into the Mojave Desert. Reible, Ouimette, and Shair (1982) reported on tracer releases made in July and early September from the San Fernando Valley and from Oildale in the San Joaquin Valley. The San Fernando Valley release was made from 0930 to 1500 PST and tracer material reached the desert area near Palmdale by 1300 PST. Tracer concentrations were observed in the southern part of the Mojave Desert, and there was no observed impact at China Lake.

The Oildale release was made from 0600 to 1100 PST, and tracer was observed later at Mojave and China Lake. The tracer concentrations were recorded at China Lake for at least 12 hours beginning at 2200 PST.

For the existing meteorological conditions during the tests, the authors concluded that the plume from the San Fernando Valley primarily affected the southern part of the Mojave Desert while the San Joaquin Valley impacted the northern part of the desert.

Smith, et al. (1983) reported on several summer tracer releases from the SoCAB with concentrations subsequently detected in the Mojave Desert. One release from Culver City between 0500 and 0900 PST reached Barstow about 1700 PST. Another release from Sylmar in the San Fernando Valley from 1000 to 1400 PST arrived at Barstow at 1900 PST. A later release from Cajon Pass from 1200-1600 PST showed peak tracer concentrations at Barstow at 1800 PST. All tracer releases were timed to coincide with peak ozone concentrations in the release area so that their impact in the desert could be evaluated.

An analysis of the wind field in the western part of the desert, including the wind energy sites downwind of the Tehachapi Mountains, led the authors to a conclusion similar to that suggested by Reible, et al. (1982):

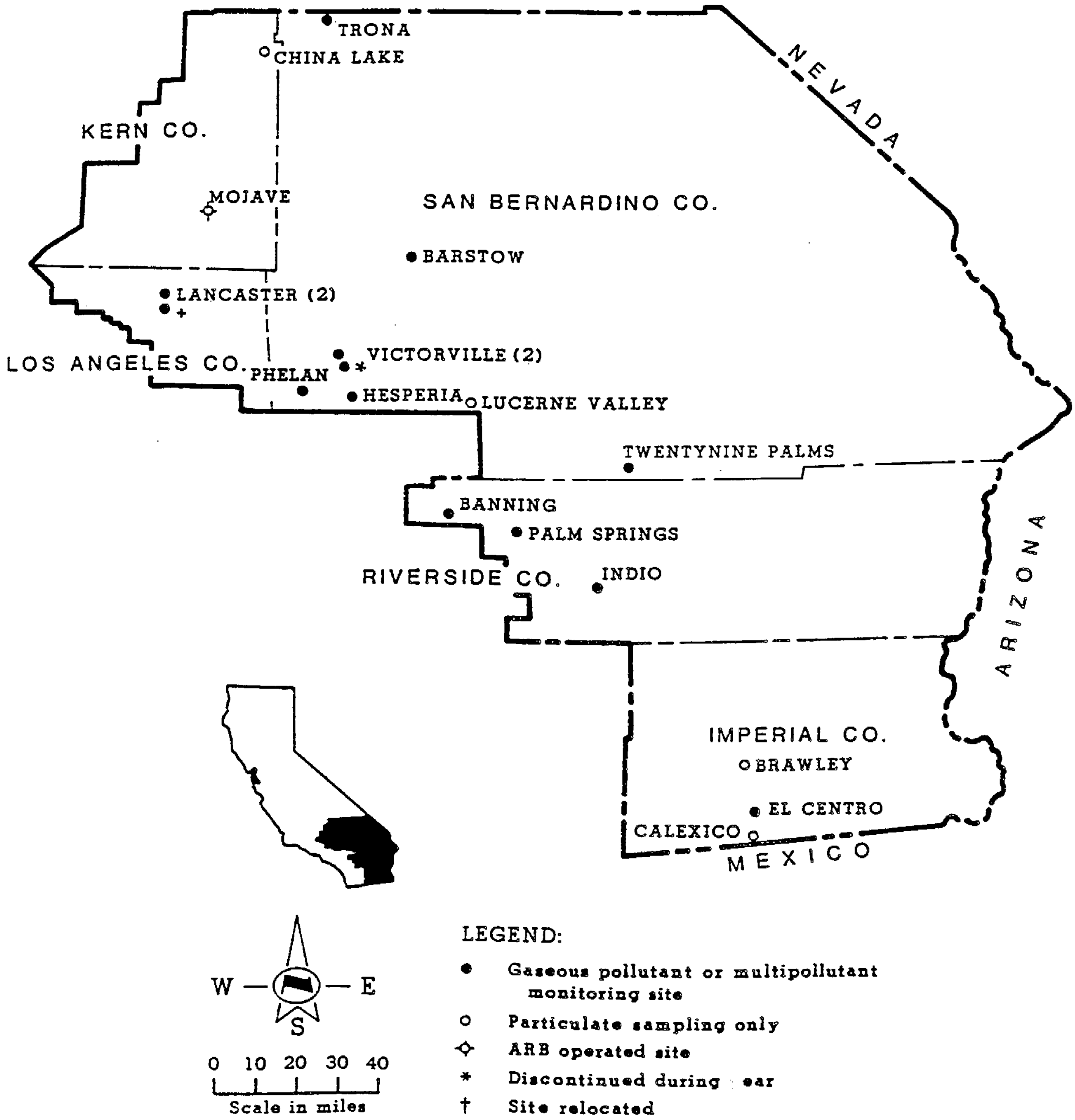



Figure 5-1. Map Showing the Southeast Desert Air Basin (SEDAB).

the boundary between the San Joaquin Valley influence (in the north part of the desert) and the SoCAB impact (in the south) was near Edwards AFB and shifted slightly to the north or south, depending on prevailing meteorological conditions.

Blumenthal, et al. (1987) drew similar conclusions about the effects of transport from the SoCAB and the San Joaquin Valley during a more detailed study of surface and upper air wind patterns. They concluded that the impact on visibility was greatest under conditions of transport from the SoCAB.

## 5.2 OZONE VIOLATIONS

This section describes the characteristics of ozone exceedances in the Mojave Desert. Diurnal and monthly variabilities are described in terms of the number of hourly exceedances of both state and federal standards. Ozone data for entrance locations (Lancaster, Victorville, Hesperia, and Phelan) and locations within the desert (Barstow, Trona, and Twentynine Palms) are presented.

Table 5-1 lists the number of state ozone exceedance days at San Bernardino County monitoring sites in the SEDAB. The number of exceedances per year is highest at Phelan and Hesperia and decreases at sites further away from the SoCAB.

Table 5-1. Southeast Desert (San Bernardino County Portion) Ozone Exceedances

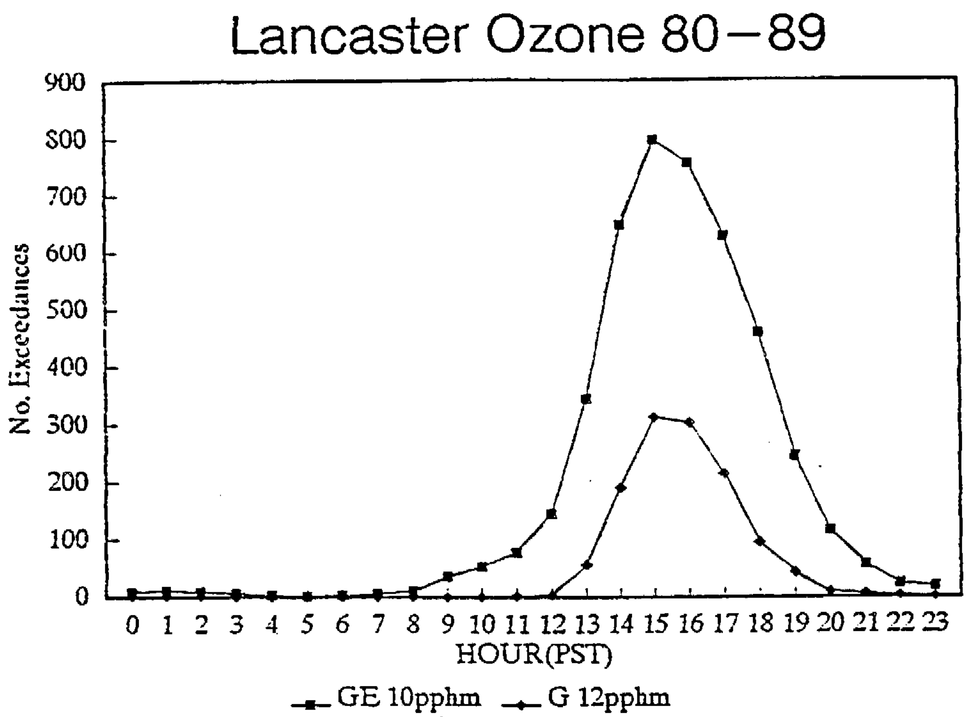
Number of Days with Maximum Ozone > 9 pphm

| Site Name | Site Number | Years of Operation* | Total | Average Per Year |
|---|---|---|---|---|
| Phelan | 36207 | 1988-1989 | 244 | 122 |
| Hesperia | 36201 | 1985-1989 | 658 | 132 |
| Victorville | 36190 | 1980-1985 | 579 | 97 |
| Victorville | 36202 | 1986-1989 | 279 | 70 |
| Barstow | 36155 | 1980-1989 | 462 | 46 |
| Trona | 36188 | 1980-1989 | 86 | 9 |
| Twentynine Palms | 36191 | 1980-85,1988-89 | 247 | 31 |

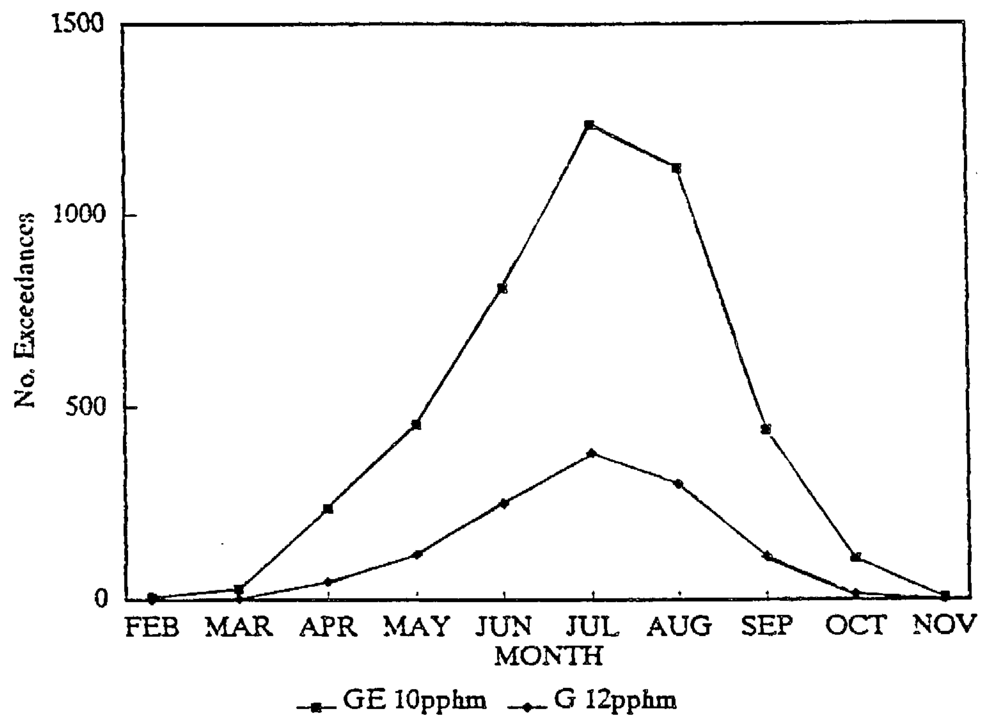
* Note that monitoring did not always start in January. Ozone data for July through September available if listed, at a minimum.

### 5.2.1 Entrance Areas

The diurnal distribution of ozone exceedance hours for Lancaster (Figure 5-2a) is uni-modal with a peak at 1500 PST. The timing of the peak indicates same-day transport from the SoCAB via Soledad Canyon, on a mean




(a)




(b)

Figure 5-2. Number of Ozone Exceedances at Lancaster by Time-of-Day (a) and Month (b).

basis. The monthly number of exceedance hours at Lancaster (Figure 5-2b) peaks in July and August with a sharp drop in September, due to a decrease in pressure gradients from the coast inland.

Victorville is the only long-term ozone monitoring station which is immediately downwind of Cajon Pass. The location of the monitor at Victorville was changed between 1985 and 1986. The ozone summaries therefore have been divided into two graphs (Figure 5-3 and Figure 5-4) for comparison. The peak number of exceedance hours occurs at 1700 PST in both data sets, two hours later than the Lancaster peak but indicative of late afternoon transport through Cajon Pass. Most monthly exceedance hours were in June, July, and August. The primary difference between the data from the two Victorville locations is in the June comparison: the 1980-85 data set had considerably more exceedances in June. The data suggest that the change in the monitoring location somewhat reduced its ozone exposure, but did not affect the diurnal timing of the ozone peak. There is a small peak at 0900 PST in the diurnal plot for 1980-85 and a slight indication of a similar effect in the 1986-89 data. This is the only indication in either the Lancaster or Victorville data of any overnight carryover of ozone or precursors in these areas.

Hesperia and Phelan have shorter ozone records than the locations described above. Hesperia has five years of record through 1989, while Phelan has only two. Peak occurrences of exceedances (Figures 5-5 and 5-6) are at 1700 PST for Hesperia and 1600 PST for Phelan, a little earlier than at Victorville. The 1700 PST peak at Hesperia changes to 1600 PST if only 1988-89 data are considered. The similarity between Phelan and Hesperia is therefore improved if comparable data bases are used.

The peak month for exceedances at Hesperia and Phelan is July, as was observed for Victorville. Note that the total number of exceedance hours for July at Hesperia (1985-89) is about the same as recorded in July at Victorville for the 10-year period (1980-89). There is a slight tendency at Hesperia and Phelan (also Victorville) for late evening ozone concentrations to linger into the early morning hours after midnight. Hesperia, in particular, has experienced state exceedances at all hours of the night.

### 5.2.2 Internal Desert Locations

Figure 5-7 gives the ozone characteristics for Barstow for the 10-year period 1980-89. The peak number of exceedances occurs at 1800 PST, about one hour after the Victorville peak and three hours after the Lancaster peak. Respective distances to Barstow are about 45 km from Victorville and 105 km from Lancaster: average wind speeds of about 10-12 m/s would be required to transport the same air mass to Barstow.

There is a significant shoulder of exceedance occurrences at Barstow from 0900 to 1400 PST. These exceedances may result from carry-over of ozone or precursors from the previous day. However, since they have a diurnal pattern closely resembling local source effects, they represent the best opportunity at Barstow for identifying possible local contributions.

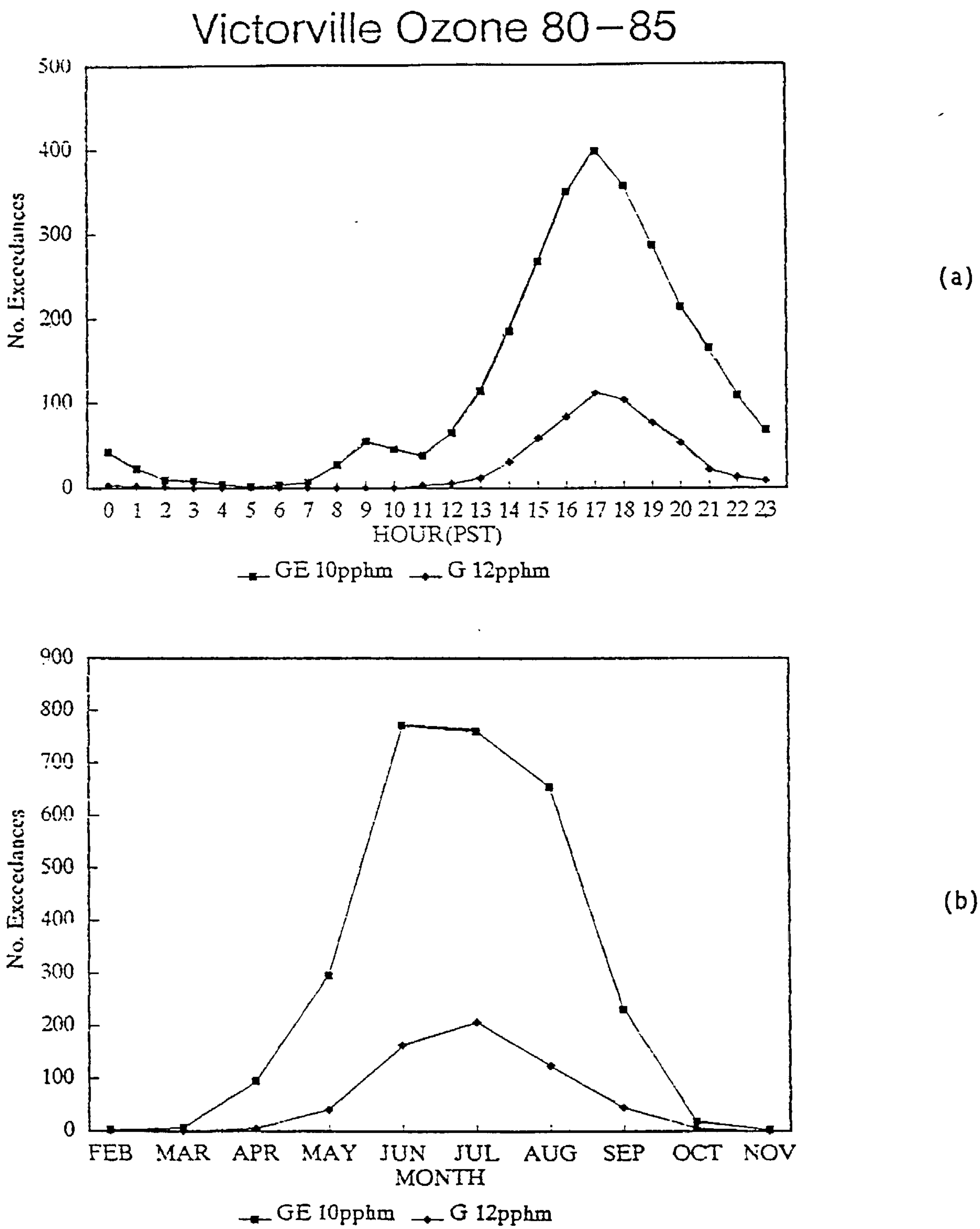



Figure 5-3. Number of Ozone Exceedances at Victorville (1980-1985) by Time-of-Day (a) and Month (b).

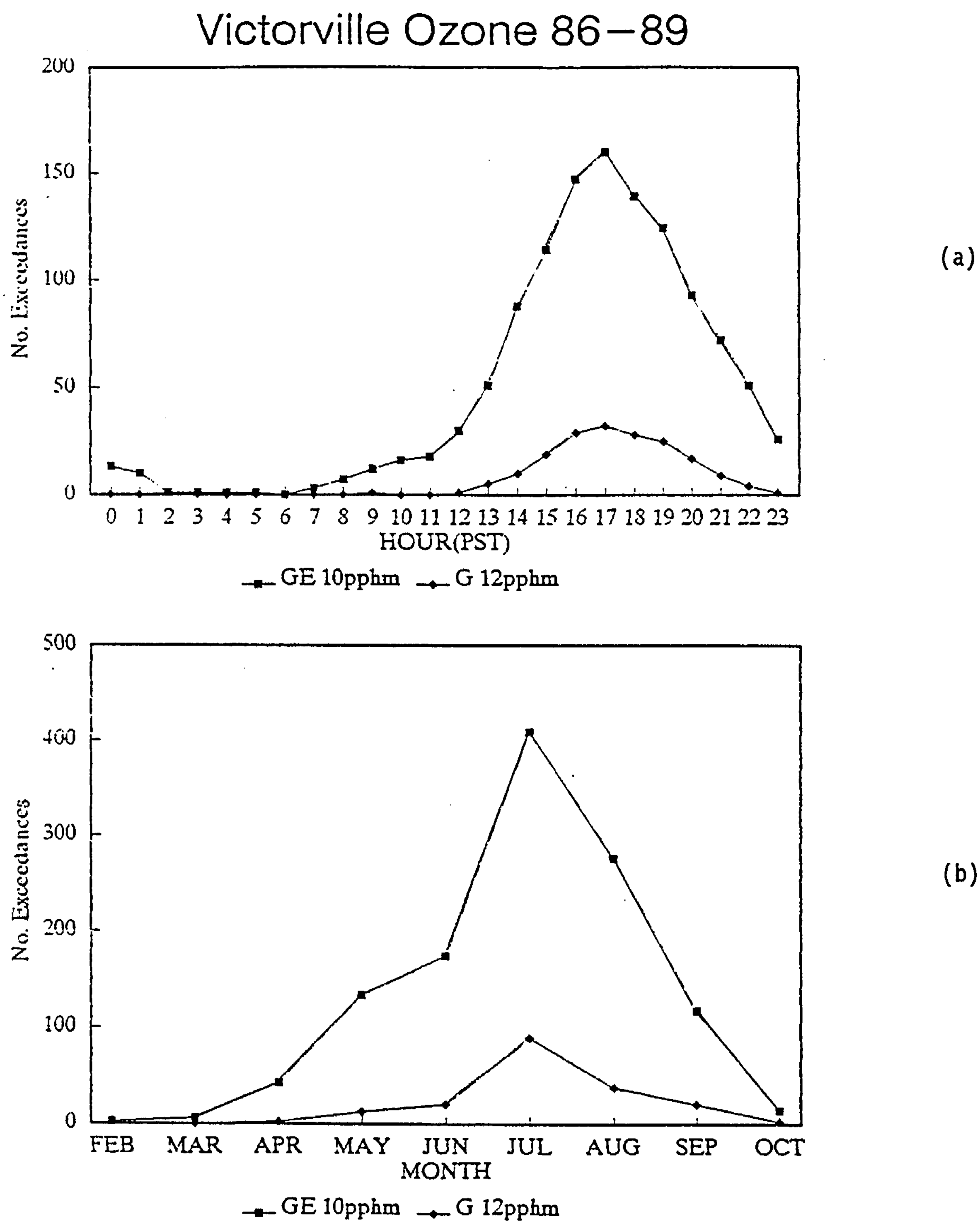
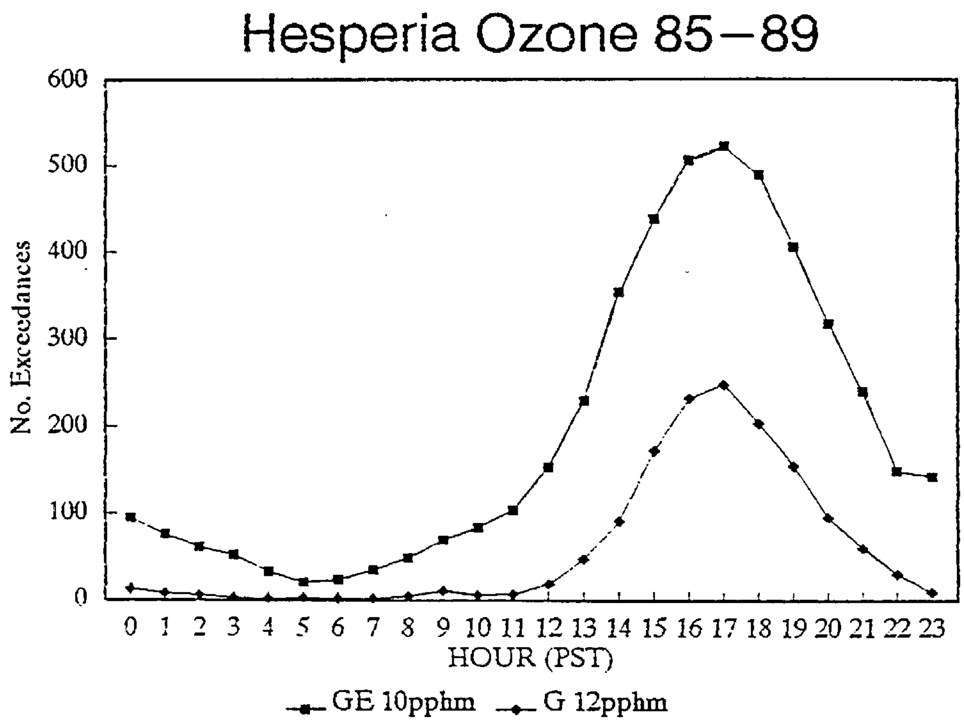
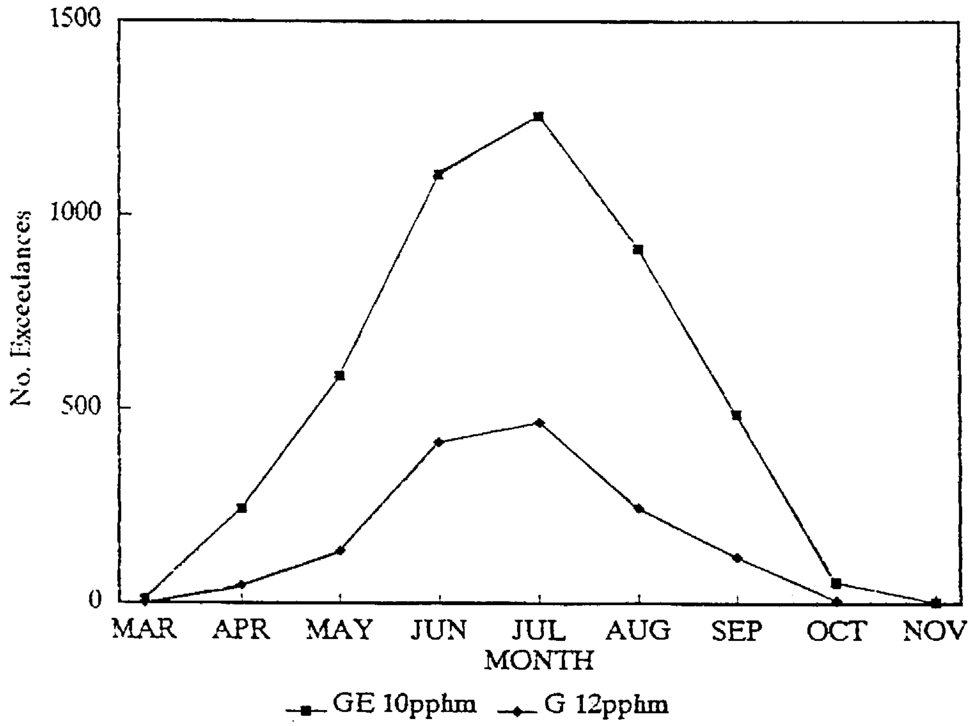



Figure 5-4. Number of Ozone Exceedances at Victorville (1986-1989) by Time-of-Day (a) and Month (b).

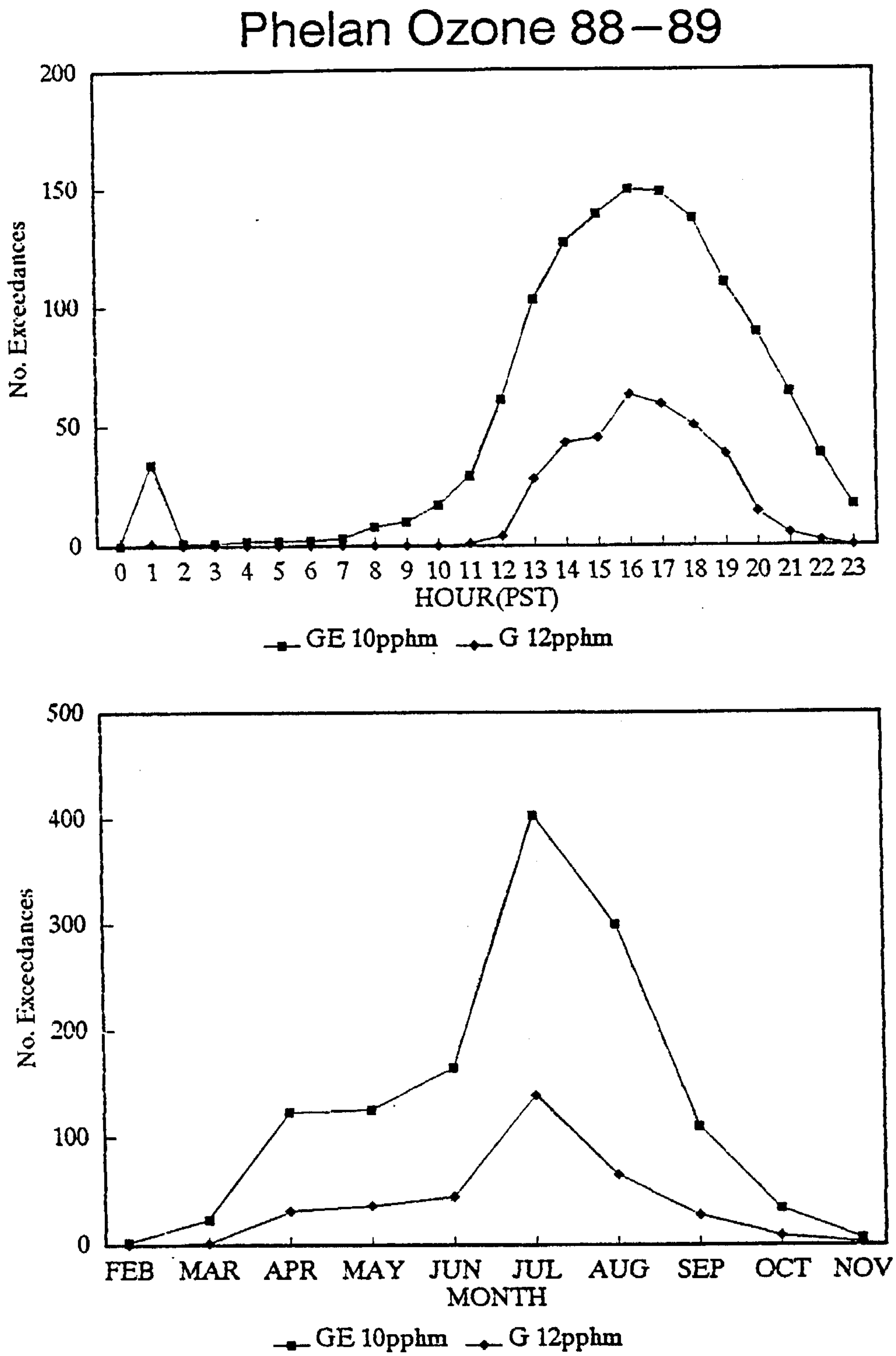



(a)




(b)

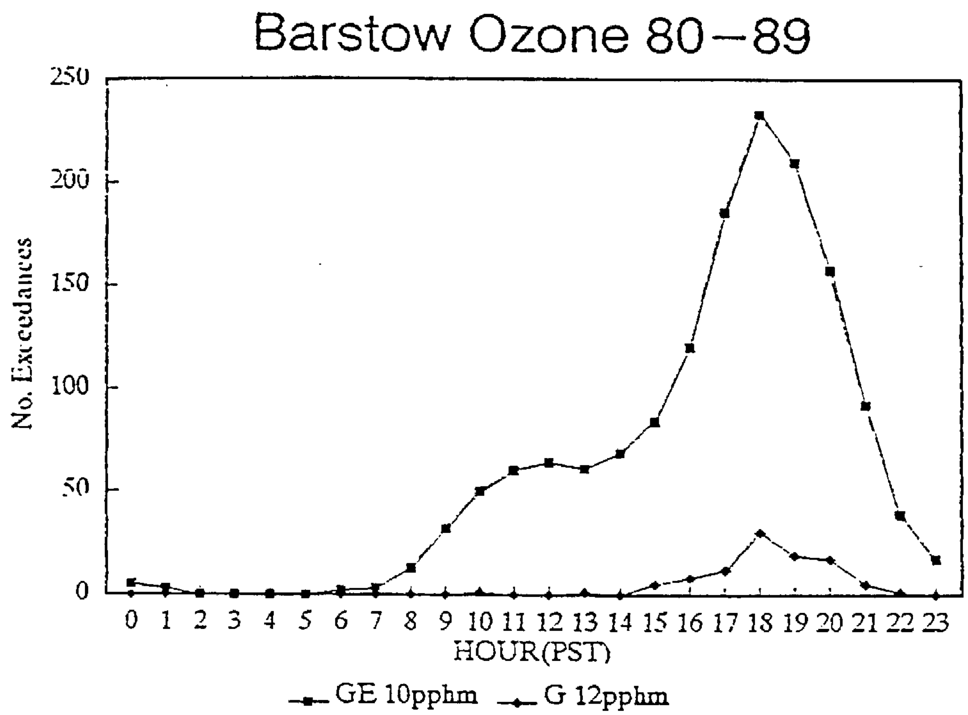
Figure 5-5. Number of Ozone Exceedances at Hesperia by Time-of-Day (a) and Month (b).



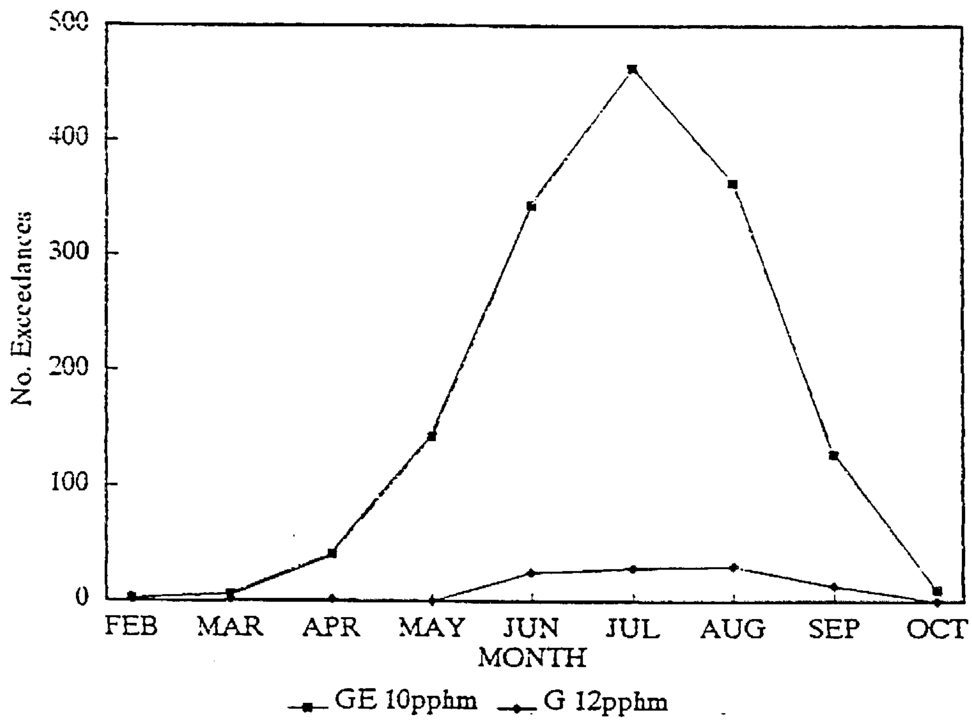

(a)

(b)

Figure 5-6. Number of Ozone Exceedances at Phelan by Time-of-Day (a) and Month (b).




(a)




(b)

Figure 5-7. Number of Ozone Exceedances at Barstow by Time-of-Day (a) and Month (b).

Peak exceedances occur in July at Barstow. This corresponds to the seasonal pattern at both Lancaster and Victorville and offers no help in distinguishing between the contributions of the two entrance areas.

The diurnal pattern of ozone exceedances for Trona (Figure 5-8) shows two distinct peaks at 1100 and 1900 PST. The late peak at 1900 PST is indicative of transport into the area. The earlier peak may be carry-over from the previous day or may include significant local effects. Most of the forenoon exceedance hours occurred in 1980 and 1981.

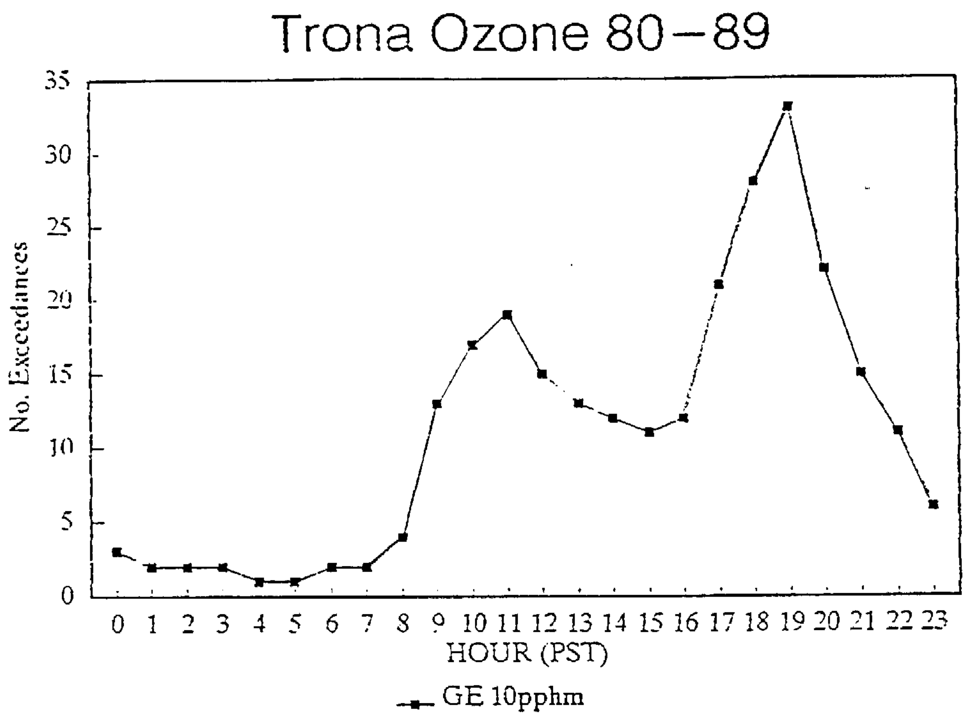
Exceedances at Trona have only been observed in June through September (see Figure 5-8). The peak number occurrs in August in contrast to the July peak at Lancaster; the peak occurrence of exceedances at Edison (in the San Joaquin Valley) is also in August.

The characteristics of ozone exceedances at Twentynine Palms are shown in Figure 5-9. There are two diurnal peaks in the number of ozone exceedances, at 0900 and 1900 PST. The late peak at 1900 PST is indicative of transport from the SoCAB, probably through Banning Pass. The diurnal peak at Banning, some 55 km upwind of Twentynine Palms, tends to occur at 1700 PST (a required wind speed of about 8 m/s). On a seasonal basis (Figure 5-9) the peak number of ozone exceedances at Twentynine Palms is in June, in contrast to the Victorville/Hesperia peaks in July. This may reflect the need for a stronger surface pressure gradient (characteristic of June) to carry ozone and precursors as far east as Twentynine Palms; later in the summer, flow may go to the Imperial Valley rather than to Twentynine Palms.

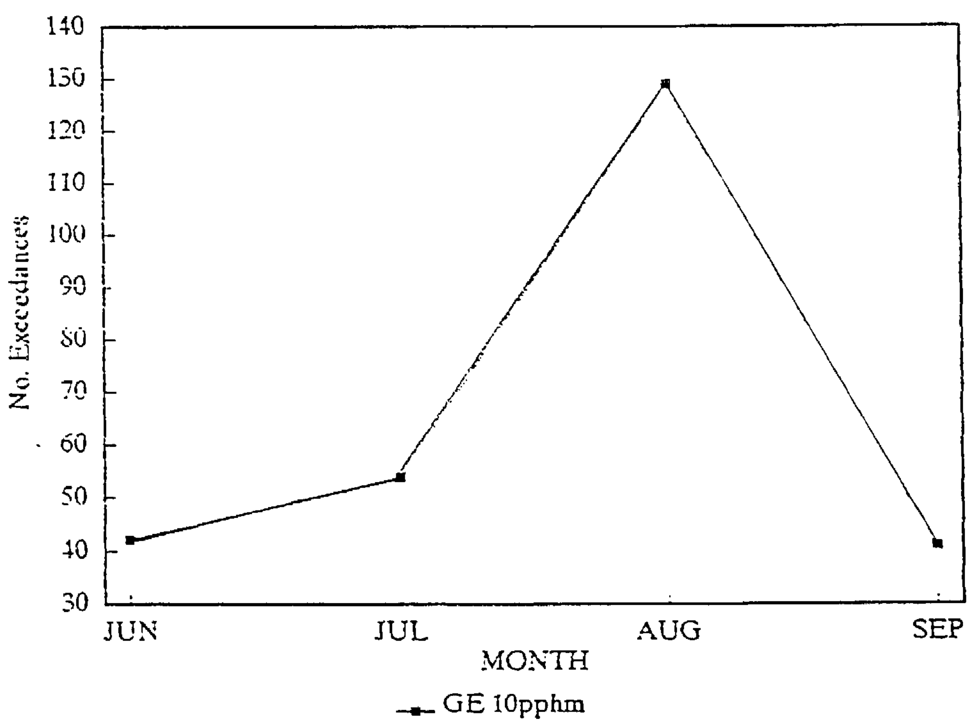
## 5.3 ANNUAL OZONE VARIATIONS

Year-to-year variability in ozone exceedances in the Mojave Desert is considerable. Figures 5-10, 5-11, and 5-12 compare the year-to-year variability for June, July, and August at Lancaster, Victorville, Barstow and Twentynine Palms. Exceedances at Lancaster were relatively high in 1981, but Victorville showed more exceedance hours than Lancaster for 1982-85. Beginning in 1986, when the Victorville site was moved to a new location, Lancaster exceedances were greater in 1986-88 and comparable to Victorville in 1989. This suggests a meteorological or emission anomaly in 1981 and a station location artifact after 1985. There is also some similarity between Barstow and Twentynine Palms exceedances, most notably in June, except for 1982.

The principal meteorological factor associated with the number of exceedances in and near the Mojave Desert is the 850 mb temperature. Average monthly values from the Loyola-Marymount soundings are included in Figures 5-10 to 5-12 for comparison with exceedance numbers. In general, 850 mb temperatures are lower in June than in July and August. Average temperatures were high in 1981 for all three months and relatively low in June 1982 and 1983 and July 1987. June and July of 1985 were warm, but August 1986 had the highest temperature in the intermediate years. July 1988 and 1989 were particularly warm, but the warm temperatures did not extend to June and August.

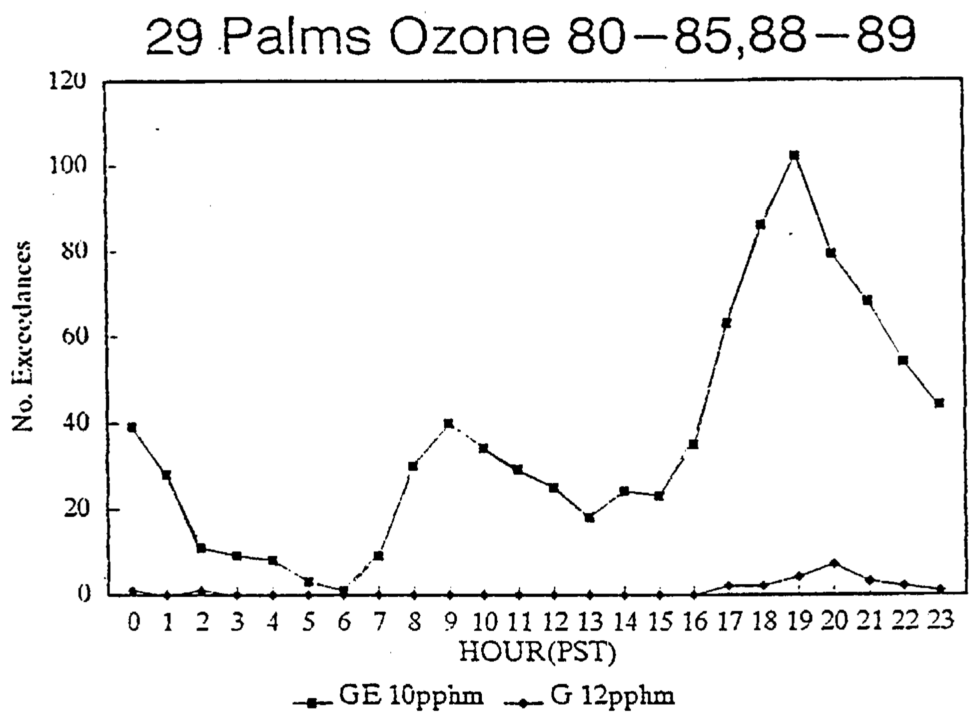



(a)

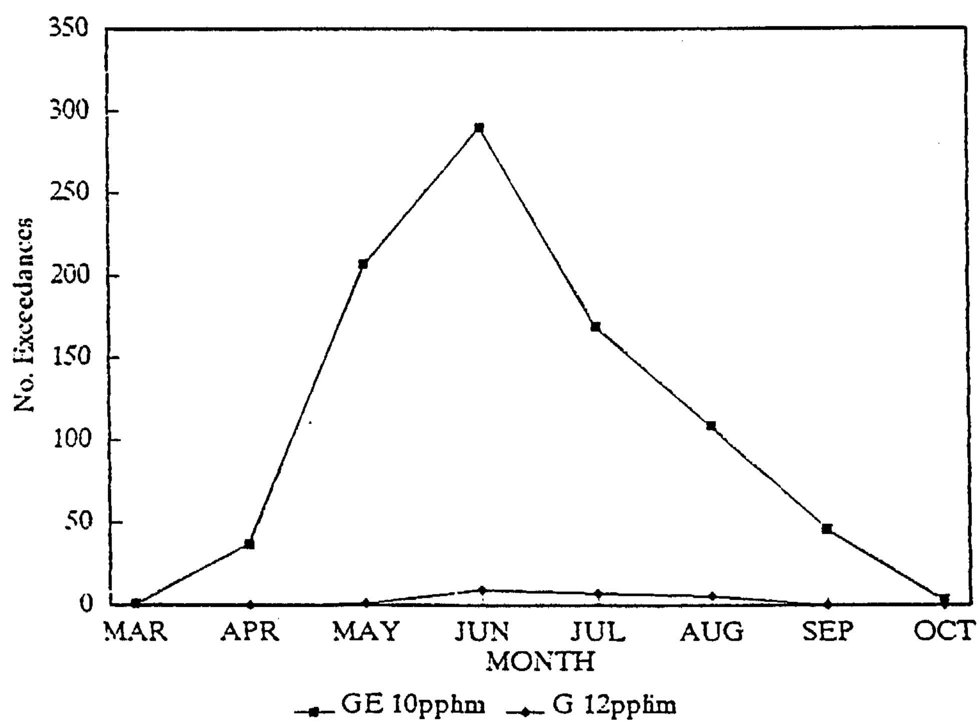



(b)

Figure 5-8. Number of Ozone Exceedances at Trona by Time-of-Day (a) and Month (b).

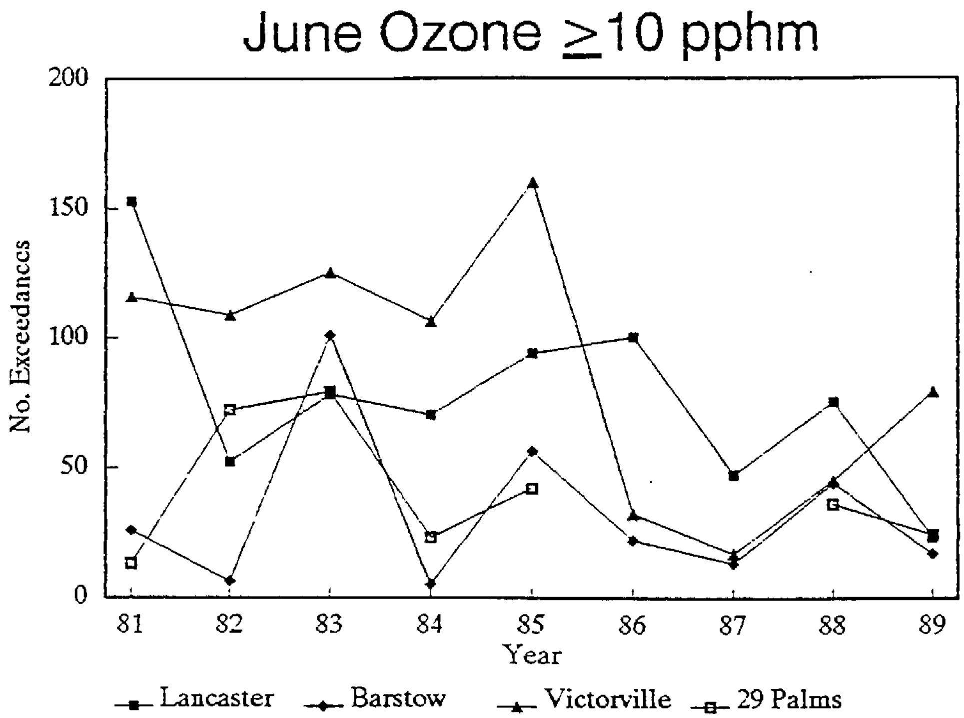



(a)




(b)

Figure 5-9. Number of Ozone Exceedances at Twentynine Palms by Time-of-Day (a) and Month (b).



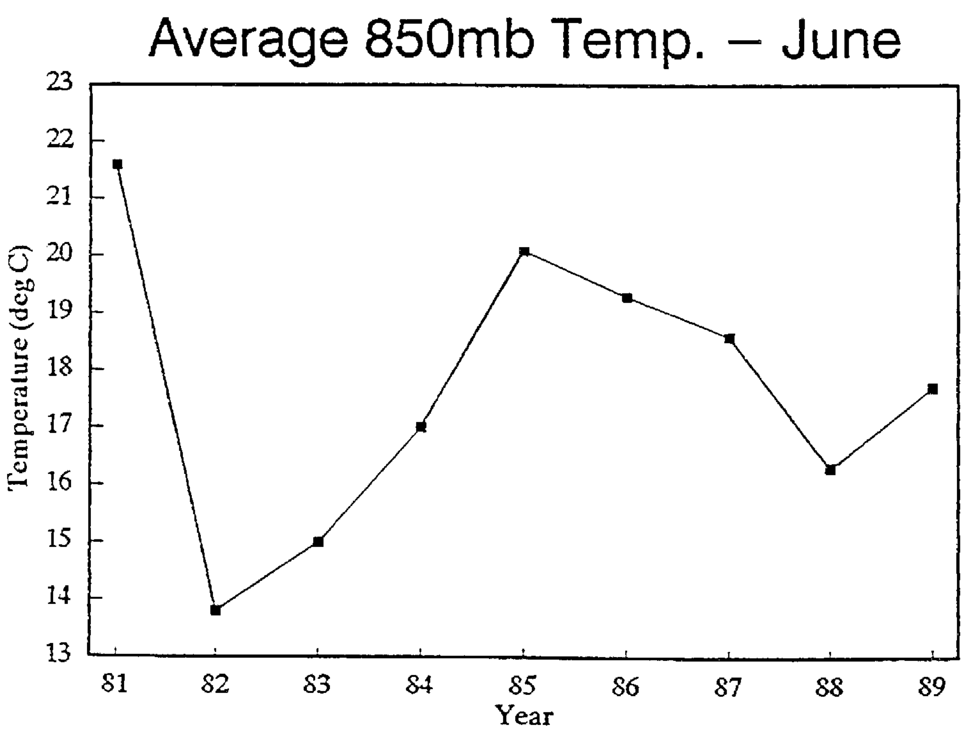
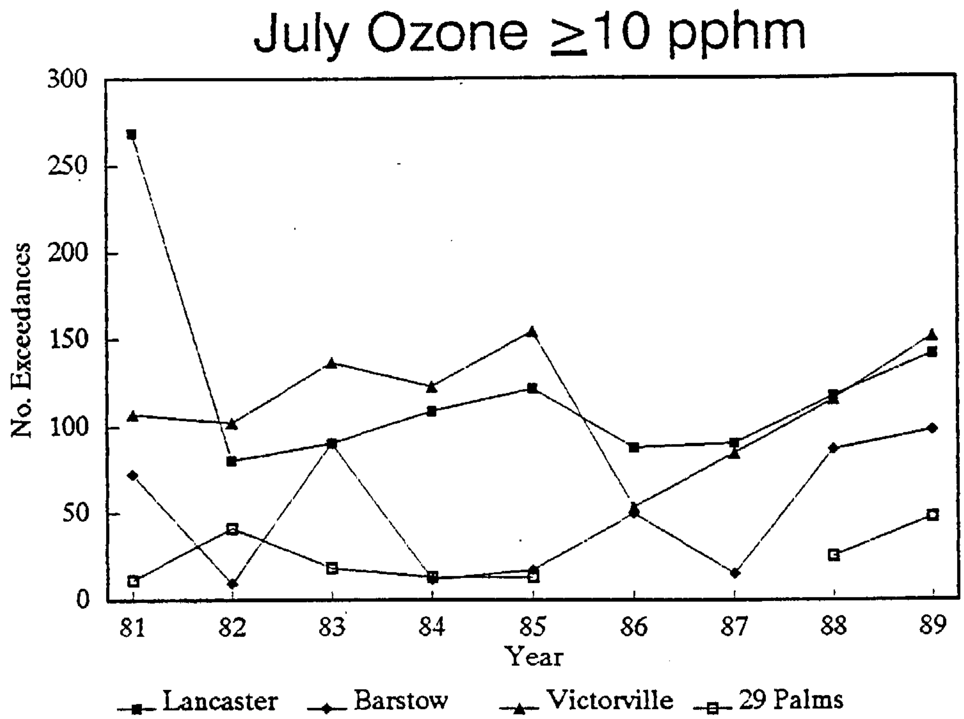




Figure 5-10. Yearly Frequency of State Ozone Exceedances at SEDAB Sites and Average 850 mb Temperature for June.



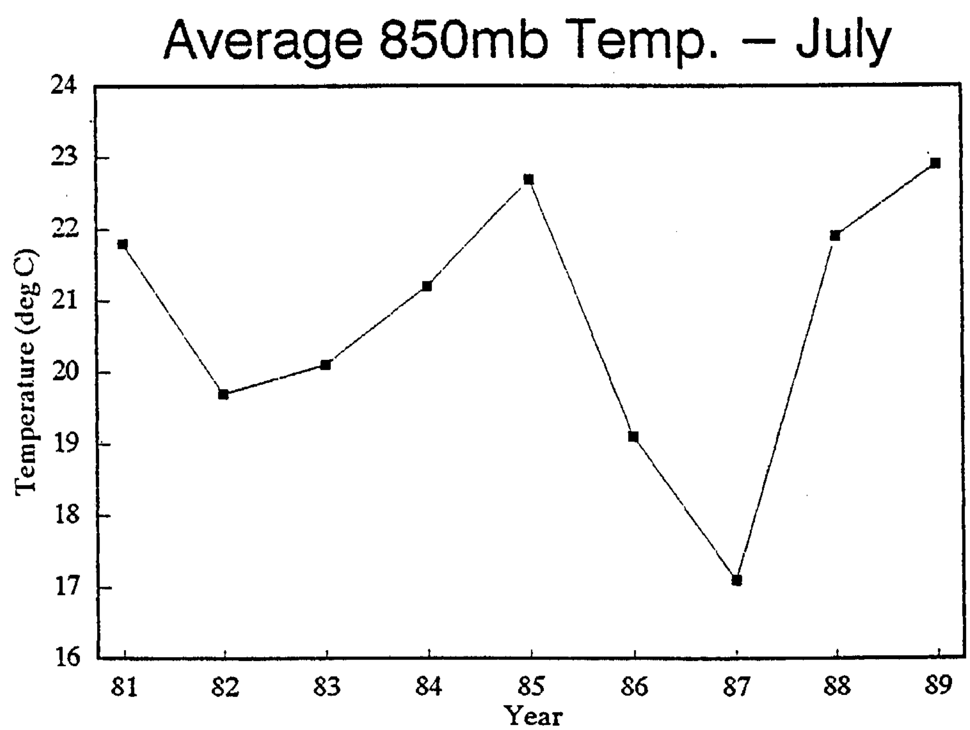
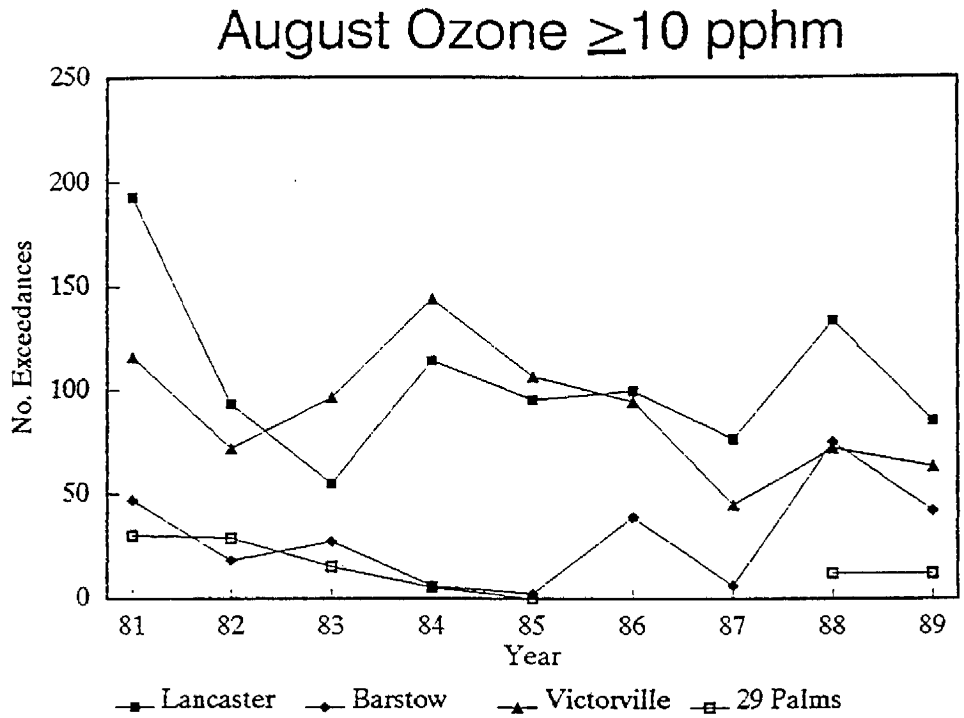




Figure 5-11. Yearly Frequency of State Ozone Exceedances at SEDAB Sites and Average 850 mb Temperature for July.



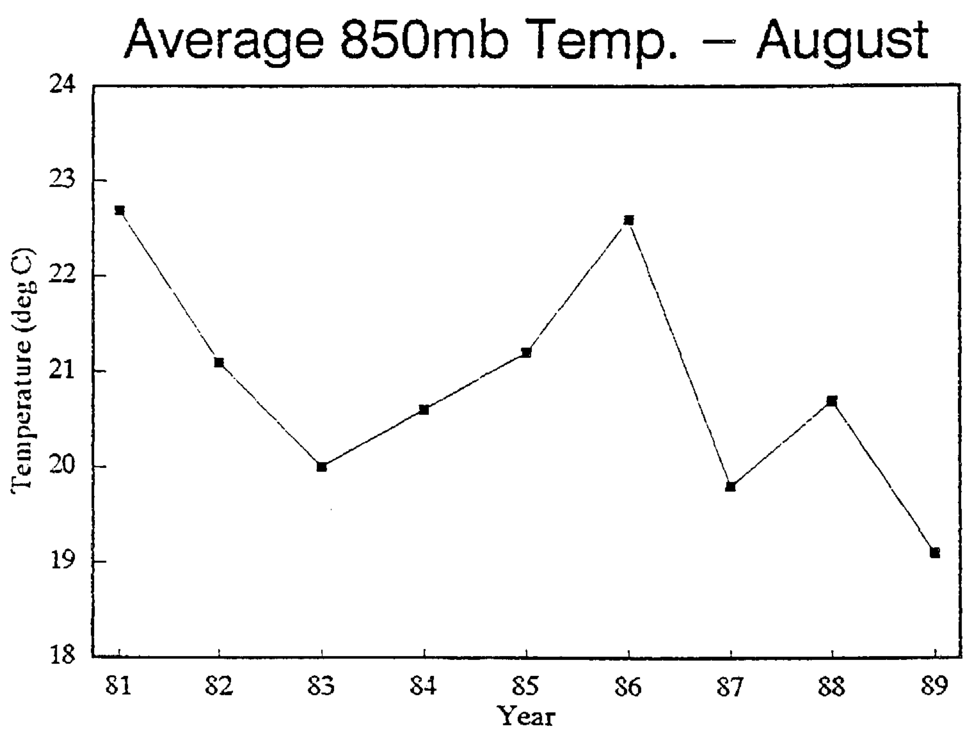




Figure 5-12. Yearly Frequency of State Ozone Exceedances at SEDAB Sites and Average 850 mb Temperature for August.

There are important similarities between the temperature and exceedance plots. The 1981 exceedance peak at Lancaster occurred in conjunction with very warm 850 mb temperatures in all three months. The 1985 temperature peak was also associated with a large exceedance peak at Victorville in June but the exceedance response in July 1985 and August 1986 was more limited. Minimum ozone exceedances occurred in conjunction with low temperatures in 1982, 1983, and 1987. It is likely that the exceedance response to meteorology which causes low temperatures is stronger and more consistent than the response to that which results in warm temperatures.

## 5.4 CORRELATION ANALYSES

Correlations were calculated for the July-August daily maximum data (1982-1989) to examine relationships between ozone concentrations at basin and desert sites and 850 mb temperatures at Loyola-Marymount as well as correlations between ozone concentrations at different monitoring locations. Table 5-2 gives the results of the temperature correlations. One characteristic of these correlations is that the stations in the basin tend to have moderately high correlations while the correlations deteriorate rapidly in the desert. Correlations between ozone stations are given in Table 5-3.

Table 5-2. Correlations Between 850 mb Temperature and Ozone (July-August, 1982-89)

| Location | r | Location | r |
|---|---|---|---|
| Burbank | 0.53 | San Bernardino | 0.58 |
| Lancaster | 0.26 | Victorville | 0.30 |
| Trona | 0.00 | Banning | 0.47 |
| Barstow | 0.16 | Twentynine Palms | 0.24 |

Table 5-3. Correlations Between Ozone Stations (July-August, 1982-89)

| Locations | r |
|---|---|
| Burbank - Lancaster | 0.19 |
| San Bernardino - Victorville | 0.32 |
| Lancaster - Victorville | 0.39 |
| Lancaster - Barstow | 0.44 |
| Victorville - Barstow | 0.37 |
| Banning - Twentynine Palms | 0.48 |

Table 5-3 indicates that correlations between locations in the SoCAB (Burbank, San Bernardino) and locations immediately downwind of the entrances to the desert are surprisingly low. This results from a number of high concentration days in the SoCAB with low inversions when high ozone concentrations do not reach the desert in substantial amounts. Banning (at 2200 ft. msl) also may not experience high concentrations under these conditions. After the ozone has traveled through the passes and entered the desert (Lancaster, Victorville, Banning) the correlations to Barstow and Twentynine Palms improve.

The lack of a strong correlation between the 850 mb temperatures and ozone concentrations at the desert locations makes it necessary to examine Figures 5-10 to 5-12 in greater detail. Lancaster and Victorville exceedances have a positive correlation with 850 mb temperatures as described in the previous section, although the Victorville relation is confused by the change in site location between 1985 and 1986. Ozone exceedances at Twentynine Palms tend to be more numerous during months of low mean temperature; June 1982 and 1983 show examples of this relation. Unfortunately, there was no monitoring at Twentynine Palms in 1987 so that the ozone characteristics for July 87 are not known. There were no significant cold months in August (1981-89). The cold 850 mb temperatures are associated with an increased onshore gradient, deeper mixing which allows transport through the passes, and stronger eastward transport conditions. This leads to the highest ozone exceedances at Twentynine Palms being recorded in 1982, a year notorious for low concentrations in the SoCAB.

As indicated by the correlation analysis above, Barstow ozone concentrations are only marginally related to 850 mb temperatures. The primary meteorological scenario contributing to exceedances at Barstow appears to be the initial phases of an increased onshore pressure gradient, which provides enough mixing to allow pollutants over the passes, but not too much to excessively dilute pollutants. This is illustrated in Figure 5-13 for June 1984. Daily maximum ozone concentrations for Lancaster and Barstow are plotted in the top part of the figure. The bottom part shows the daily variations in 850 mb temperatures and in 0700 PST pressure gradients from San Diego to Las Vegas (SANLAS) and from Los Angeles to San Francisco (LASF).

The state exceedance days at Barstow correspond to the initiation of onshore gradient periods. The correspondence between exceedances and 850 mb temperatures in Figure 5-13 is not as significant. In particular, the warm temperatures aloft after June 18 were not associated with exceedances at Barstow although high ozone concentrations were recorded at Lancaster. Warm temperatures aloft, accompanied by negative pressure gradients from Los Angeles to San Francisco, tended to confine pollutants to the SoCAB and reduce the transport into the Mojave Desert.

## 5.5 TRAJECTORY ANALYSES

Mean winds at the available observing locations in the Mojave Desert have been analyzed for exceedance days at Barstow, Trona, and Twentynine Palms. The data summaries in Table 5-4 represent the wind characteristics at each of the stations on those days when state exceedances occurred at Barstow, Trona, or Twentynine Palms. The appropriate time for each wind summary was determined from the peak ozone time for that location, i.e., the wind statistics follow the ozone peak as it moves through the area. Days with state exceedances occurring before 1500 PST were excluded as being

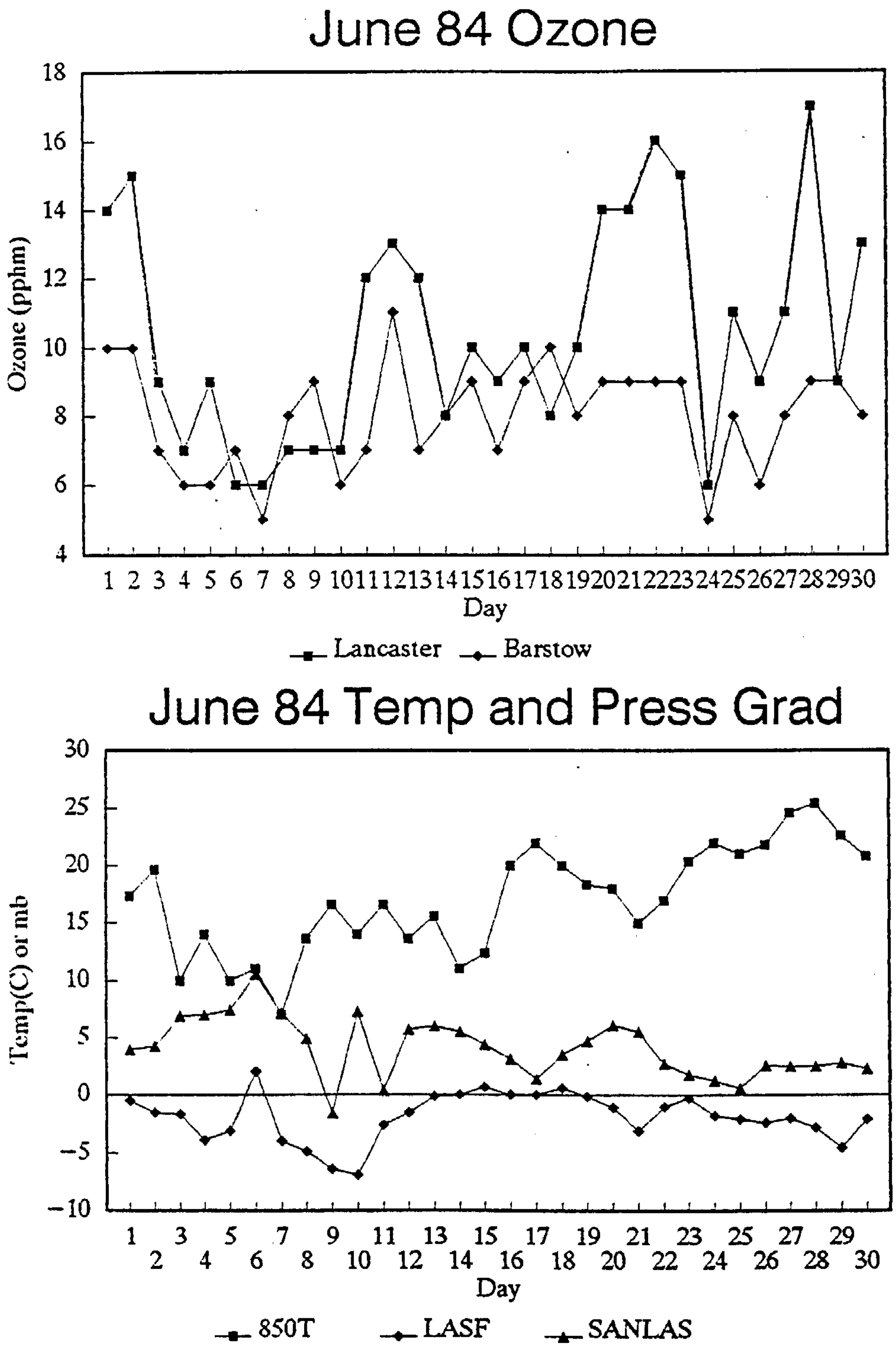



Figure 5-13. Daily Ozone Maximum at Lancaster and Barstow and Meteorological Variables for June 1984.

representative of a different meteorological condition and were considered separately.

Table 5-4. Mean Winds for July-August Exceedance Days (1981-89) When First Exceedance Hour ≥1500 PST

| Wind Location (time) | Barstow | | Trona | | 29 Palms | |
|---|---|---|---|---|---|---|
| | wd | ws | wd | ws | wd | ws |
| Lancaster (1500 PST) | 245° | 8.9 m/s | 245° | 9.9 m/s | 240° | 8.8 m/s |
| Edwards AFB (1600 PST) | 230 | 7.4 | 240 | 6.2 | 240 | 5.7 |
| China Lake (1900 PST) | 235 | 3.6 | 215 | 4.1 | 260 | 3.7 |
| George AFB (1700 PST) | 185 | 5.3 | 185 | 5.7 | 200 | 5.2 |
| Daggett (1800 PST) | 240 | 6.6 | 240 | 6.4 | 250 | 6.2 |

Most of the mean wind values are similar for all three exceedance locations and many, but not all, of the exceedance days occur simultaneously at two or more monitoring stations. The primary difference in Table 5-4 is at China Lake for Trona exceedances: a more southerly direction is evident in contrast to the exceedance days at Twentynine Palms which are characterized by a more westerly wind. The data for George AFB and Daggett reflect this veering of the winds to a lesser degree.

There are secondary wind frequency peaks in the data from George AFB and Daggett. These occur at 270° and 290°, respectively. They indicate that, on a limited basis, the flow in the Mojave Desert is more westerly than indicated in Table 5-4. In this case, Barstow is more likely to be influenced by flow from Soledad Canyon or the San Joaquin Valley than from Cajon Pass.

The winds shown in Table 5-4 have been plotted in Figure 5-14 for Barstow exceedance days when the ozone concentration peaked at 1500 PST or later. Streamlines were drawn to indicate the flow in the Mojave Desert leading up to the time of peak ozone concentration at Barstow. Mean times have been estimated along the streamlines from Soledad Canyon and Cajon Pass, assuming steady state. These are shown as tick marks in Figure 5-14 starting with the peak hours of 1500 PST at Lancaster and 1700 PST at Victorville. The times indicate that the peak exceedance at Barstow would occur at 1800-1900 PST, about the same as the observed time of 1800 PST.

The typical flow from Soledad Canyon moves to the northeast, passing to the north of Barstow on a mean basis. The flow through Cajon Pass turns sharply to the northeast and may pass near Barstow on a mean basis. On Barstow exceedance days, the mean wind at China Lake seems to be more influenced by the San Joaquin Valley than by the western Mojave Desert. On Trona exceedance days (Table 5-4), the mean wind at China Lake of 215° does not suggest flow from the western Mojave Desert but from the San Joaquin Valley. The mean flow conditions associated with exceedance days at Twentynine Palms are essentially the same as shown in Figure 5-14 and support transport from San Gorgonio Pass.

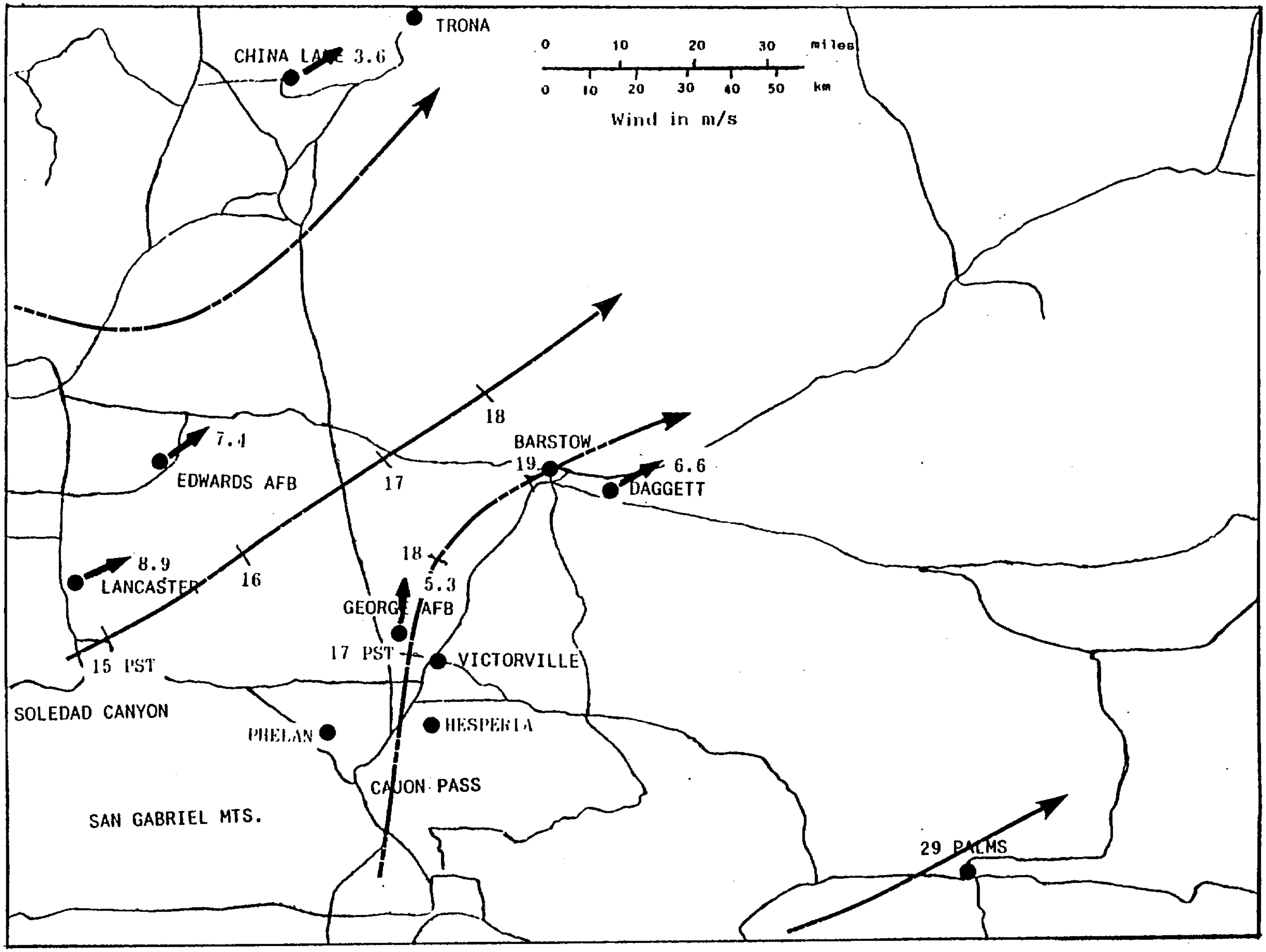



Figure 5-14. Mean Surface Streamlines for Afternoon Exceedance Days at Barstow. Estimated times along streamlines assume steady state flow.

These results indicate that during ozone exceedances, Barstow is most frequently impacted by flow through Soledad or Cajon Pass, as opposed to flow from the San Joaquin Valley. This result is consistent with the tracer results of Smith, et al. (1983), where $SF_6$ tracer released from the SoCAB was consistently transported to Barstow.

A similar analysis was carried out for exceedance days when the first hour of exceedance occurred by 1200 PST at the respective locations. The wind observations summarized in Table 5-5 refer to the first hour of exceedance on each day. The appreciable occurrence of calms is denoted by a C, together with a mean direction for the remaining cases.

Table 5-5. Mean Winds for July-August (1981-89) Exceedance Days When First Exceedance Hour ≤1200 PST

| | Barstow | | Trona | | 29 Palms | |
|---|---|---|---|---|---|---|
| Wind Location | wd | ws | wd | ws | wd | ws |
| Lancaster | C 250° | 3.6 m/s | 250° | 5.5 m/s | | |
| Edwards AFB | C 240 | 2.6 | 230 | 2.6 | | |
| China Lake | | | C | 1.1 | | |
| George AFB | C 180 | 2.0 | | | | |
| Daggett | 300 | 3.8 | | | 300° | 5.1 m/s |

Barstow exceedances which begin by 1200 PST are characterized by low wind speeds and frequent calms at Lancaster, Edwards AFB, and George AFB. Daggett winds at the time of the first exceedance hour were more northwesterly at 3.8 m/s with only a few calms.

The wind characteristics preceding and following the first exceedance hour (by 1200 PST) at Barstow are explored in Table 5-6. The northwest flow at Daggett prevails for at least two hours prior to and following the first exceedance hour. The characteristic flow pattern, on a mean basis, suggests transport from the west-northwest in those cases of forenoon exceedances.

Table 5-6. Mean Winds at Daggett Preceding and Following First Exceedance Hour at Barstow

| 0 hrs. | +1 hr. | +2 hrs. | -2 hrs. | -4 hrs. |
|---|---|---|---|---|
| 300° 3.8 m/s | 290° 3.9 m/s | 300° 4.0 m/s | 300° 4.9 m/s | 260° 4.6 m/s |

Early occurrences at Trona (Table 5-5) primarily indicate very light winds at China Lake at the time of the first hour of exceedance; Lancaster and Edwards AFB wind data do not exhibit any unique features. Exceedances at

Twentynine Palms by 1200 PST are characterized by west-northwest flow at Daggett with somewhat higher velocities than occur with the Barstow exceedances.

## 5.6 DISCUSSION OF TRANSPORT ISSUES

The exceedance cases have been divided into two categories: (1) those with peak ozone concentrations occurring at 1500 PST or later and (2) those with the first hour of exceedance at 1200 PST or earlier. The two categories are not mutually exclusive but seem to reflect different exceedance scenarios. During the period of 1981-89 there were 332 days with state exceedances at Barstow in the first category. There were 109 days with exceedances beginning at least by 1200 PST.

### 5.6.1 Afternoon Ozone Peaks

Peak concentration times at Lancaster and Victorville were compared to the Barstow peak time for those days with peak concentrations at Barstow at 1500 PST or later. A difference in peak times of two to four hours for Lancaster/Barstow and one to three hours for Victorville/Barstow were considered acceptable transport times for simple advection of the ozone peak across the desert. A vast majority of the afternoon peaks at Barstow satisfied these criteria.

There were two types of deviations from this scenario. First, an exceedance occurred at Lancaster or Victorville but the difference in timing compared to Barstow did not fit the above criteria; or second, there was no exceedance at Lancaster or Victorville but a late afternoon exceedance occurred at Barstow. The latter are the strongest candidates for local contributions to the ozone exceedance. Table 5-7 lists the dates when the timing differences did not fit the appropriate criteria.

Table 5-7. Exceedance Days at Barstow with Poor Transport Timing Differences

| Date | Peak $O_3$ | Time (PST) | Date | Peak $O_3$ | Time (PST) |
|---|---|---|---|---|---|
| 5/13/81 | 10 pphm | 1300-1400 | 5/ 5/85 | 10 pphm | 1400 |
| 4/23/82 | 10 | 1900 | 5/27/85 | 10 | 1600 |
| 5/20/82 | 10 | 1900 | 7/ 7/86 | 10 | 1400 |
| 6/23/82 | 13 | 1600-1700 | 7/ 9/86 | 10 | 1500 |
| 6/04/83 | 10 | 1300-1700 | 7/10/86 | 11 | 1500 |
| 6/29/83 | 11 | 1900 | 8/20/86 | 10 | 1700, 2000 |
| 6/18/84 | 10 | 1300 | 6/ 4/88 | 10 | 1400 |
| 4/28/85 | 10 | 1700 | 8/25/89 | 10 | 1400 |

Uncertain trajectories in the desert during these periods and the possible effects of residual ozone concentrations make the evaluation of these cases difficult and somewhat ambiguous. A number of the cases are close to a reasonable transport scenario, but do not fit the specific timing criteria above. Of more interest are the cases listed in Table 5-8 which show those days when an afternoon exceedance occurred at Barstow without a same-day exceedance at either Lancaster or Victorville.

Table 5-8. Exceedance Days at Barstow Without Lancaster or Victorville Exceedances

| Date | Peak $O_3$ | Time (PST) |
|---|---|---|
| 6/02/83 | 10 pphm | 1800 |
| 6/27/83 | 10 | 1800 |
| 5/31/85 | 10 | 1400 |
| 9/07/86 | 10 | 1800 |
| 4/19/89 | 10 | 1400, 1900 |
| 10/14/89 | 10 | 1300 |

None of the cases in Table 5-8 are very significant exceedances. All lasted only one hour, with the exception of 4/19/89 (two hours). With the exception of 6/2/83, the peak ozone concentrations at Lancaster/Victorville were 8 or 9 pphm on each of the days in the Table. The Barstow exceedances in those cases could thus be interpreted as a shared contribution from the desert area or as continued reaction in the desert in an environment of reduced nitrogen oxides. The same factors may play a role in the cases shown in Table 5-7. The 6/2/83 case is discussed in Section 5.6.2 in connection with a four-day episode.

During the period of 1981-89 there were 62 days with afternoon state exceedances at Trona. Twenty-six of these occurred in 1981. Figures 5-10 to 5-12 indicate that Lancaster also had a high number of exceedances in June-August 1981. However, there were 10 afternoon exceedances at Trona in 1985 without a similar increase in exceedances at Lancaster.

A typical transport time from Lancaster to Trona should be four to six hours, given the characteristic wind speeds at China Lake, Edwards AFB, and Lancaster and the intervening distance (135 km). Only 15 of the 62 exceedance days fit this criterion. In addition, there were eight Trona days when no exceedance was recorded at Lancaster. Because of the scarcity of wind observations north of Edwards AFB, it is not possible to distinguish between Soledad Canyon and San Joaquin Valley influences on Trona on the basis of trajectories. However, the available information suggests very limited impact from Soledad Canyon.

During the periods 1981-85 and 1988-89, there were 163 days at Twentynine Palms with peak ozone concentrations at 1500 PST or later. On all but six of these days, there was also an earlier exceedance at Banning, which is on the most likely transport route to Twentynine Palms. On the six days at Banning without exceedances, peak ozone concentrations ranged from 6 to 9 pphm. Subsequent reactivity in the desert after passing through Banning could result in increased ozone concentrations at downwind locations such as

Twentynine Palms, especially if it was cloudy in the basin as is typical in June.

### 5.6.2 Forenoon Exceedances

During the period of 1981-89 there were 109 days with state ozone exceedances at Barstow which began by 1200 PST. As indicated in Table 5-5, the mean wind at Daggett during the first hour of exceedance on these days was 300° at 3.8 m/s. Consideration of the Daggett winds for the four to six hour period prior to the beginning of the exceedance would suggest an origin of the air in the western part of the Mojave desert at 0600 PST, on a most frequent basis. On the previous day, this air could have been transported from either the SJV or the SoCAB.

There is another wind characteristic in the Daggett data which is of importance in assessing transport in the area. The wind velocity at Daggett frequently decreases gradually during the forenoon. On occasion, during the late forenoon, the west to northwest flow stops and is replaced by an east to southeast regime. At the same time, from midnight into the forenoon, the flow at George AFB is from the south. This flow could transport material from the Victorville area to a region southeast of Barstow where it can move into Barstow if the east to southeast regime occurs. This is supported by haze reports to the southeast of Daggett and by the frequent occurrence of high ozone at Barstow simultaneous with the appearance of the southeast regime.

The Daggett winds at the beginning of exceedances generally indicate transport from the western part of the desert. The hypothesis of an east to southeast regime permits transport from the Victorville area. These two areas (western Mojave and Victorville) appear to be the main regions where nocturnal winds become light enough to permit overnight carry-over of ozone and precursors from the previous day. The Daggett area experiences high wind speeds during the night and only occasionally would permit substantial carry-over. Carry-over into the early morning hours was apparent at Lancaster, Victorville, or Barstow on nearly half of the 109 days of early exceedances.

An objective of this study was to identify exceedance days in which a case for local contributions could be made. For this purpose, exceedance days were selected for which neither Lancaster nor Victorville experienced an exceedance on the previous day. This was intended to reduce the likelihood of carry-over contributions from the previous day. Each of these days was examined in some detail. This resulted in the following list of Barstow exceedance days which are most likely to contain the effects of local contributions (see Table 5-9).

Table 5-9. Barstow Exceedance Days with Possible Local Effects

| | |
|---|---|
| Sept. 22, 1982 | Nov. 5, 1983* |
| June 1, 1983 | Sept. 15, 1987 |
| June 3, 1983* | March 19, 1988* |
| Aug. 10, 1983 | Sept. 15, 1989* |

* No Lancaster or Victorville exceedance on this date

All of these days (except June 1 and 3) have near zero to negative pressure gradients from the coast inland, suggesting light winds in the desert. None of the days (except June 1) show early morning indications of carry-over of ozone concentrations in the monitored areas. It is possible, however, that significant carry-over could be present in unmonitored areas of the desert. On four of the days (indicated by asterisks) there was no exceedance at Lancaster or Victorville, even though the state standard at Barstow was exceeded on that day. In terms of significance, June 1, 1983 (four hours of exceedance) and August 10, 1983 (five hours) appear to be the most important examples.

The June 1, 1983 exceedance is an interesting case. Surface winds at Daggett were from a westerly direction at 17-26 knots throughout the night and during the exceedance hours. Stronger gusts were reported. Haze and blowing dust accompanied the strong winds. The 850 mb temperature was 6.2°C, not conducive to high ozone concentrations. Peak ozone concentrations at Lancaster and Victorville were 6 and 7 pphm. respectively. There was no other exceedance reported in the entire state on that day. Ozone concentrations at Barstow were at least 6 pphm all day, except for a value of 5 pphm at 2200 PST. Four hours of exceedances occurred from 1200-1500 PST. Surface winds decreased somewhat in the next few days but exceedances also occurred through June 4. The continued high level of concentrations throughout the day on June 1 suggests transport from a widely dispersed source area or a dust contamination problem with the monitor.

There were 24 forenoon exceedance days at Trona during the period of 1981-89. Seventeen of these occurred during 1981. Data in Table 5-5 indicate that China Lake winds at the time of the first exceedance hour averaged 1.1 m/s with frequent calms. Figure 5-8a indicates that the peak morning exceedances at Trona occurred from 1000-1100 PST which suggests local, morning emissions contributions which become dispersed by noon, or carry-over from the previous day as was indicated in the tracer release reported by Reible, et al. (1982).

There were 42 days at Twentynine Palms (1980 to 1985 and 1988 to 1989) when the first hour of exceedance occurred after 0400 PST but by 1200 PST. There were another 48 days when the first exceedance hour was between 0000 and 0400 PST. The latter are clearly the result of late-arriving pollutants and indicate the strong influence of the previous day in the Twentynine Palms area. For those 42 days with exceedances beginning between 0400 and 1200 PST, ozone concentrations at Twentynine Palms during the early morning hours were relatively high. In 41 of the cases, morning concentrations (0000-0600 PST) ranged from 6-9 pphm. A minor amount of reaction after 0600 PST, or mixing of elevated layers to the surface, could therefore produce exceedances in the area. The early morning concentration data from Twentynine Palms indicate that the area is subjected to late-arriving transport on many nights; whereas, the other Mojave Desert monitoring sites show such effects on a more limited basis.

As in some of the Barstow cases, some of the forenoon exceedance cases at Twentynine Palms which are not related to same-day transport might be attributed to reactivity of prior-day precursors or, possibly, to small local contributions.

## 5.7 CONCLUSIONS

Based on our analyses, we made the following conclusions:

- Lancaster and Victorville serve as the primary entrance monitoring sites for transport from the South Coast Air Basin into the Mojave Desert. Peak exceedances at Lancaster and Victorville occur at 1500 and 1700 PST, respectively, and in July. There is little indication of forenoon exceedances which might be related to carry-over from the previous day.

- Peak exceedances occur later in the day at Barstow (1800 PST) and at Twentynine Palms (1900 PST). The mean timing differences between these locations and the entrance areas are compatible with simple transport of the ozone peak through the desert.

- Trajectory analyses and tracer results suggest that during ozone exceedances, Barstow is most frequently impacted by flow through Soledad Canyon or Cajon Pass. Barstow seems to be infrequently influenced by westerly transport from the San Joaquin Valley. Trona appears to be influenced primarily by flow from the San Joaquin Valley. Twentynine Palms receives material from the South Coast Air Basin through Banning Pass.

- Primary analysis efforts were devoted to exceedances at Barstow. Exceedance days were divided into afternoon and forenoon cases. Attempts to identify possible local contributions resulted in identification of six days when afternoon exceedances occurred at Barstow, but no exceedance was recorded at Lancaster or Victorville. Ozone concentrations during these Barstow exceedances were only 1-2 pphm higher than at either Lancaster or Victorville; these exceedances were attributed to continued reaction in the desert or possible local contributions. San Joaquin Valley contributions to Barstow exceedances via overnight or early morning transport into the desert are possible, but were not identified in these cases.

- Analyses of forenoon exceedances at Barstow identified eight exceedance days with most likelihood of experiencing local contributions. None of these days was preceded by exceedance days at Lancaster or Victorville. Most of the days showed no evidence of early morning carry-over at the available monitoring sites. Four of these Barstow exceedance days showed no exceedance at Lancaster or Victorville. Barstow exceedances are attributed to additional, second-day reaction of morning precursors or the effects of local contributions.

- Trona and Twentynine Palms analyses were similar to those described for Barstow. Exceedance days with potential local contributions may also be the result of additional reaction in the desert area. The analyses indicated that the Twentynine Palms area was particularly conducive to the effects of carry-over from the previous day.

# 6. TRANSPORT TO IMPERIAL COUNTY

The Imperial Valley has experienced occasional exceedances of the state ozone standard, but the federal standard was exceeded on only two days during the period 1981-89. More frequently, visibilities in the Valley were reduced significantly by particulate concentrations, occasionally enhanced by humidity effects.

There has been only one long-term ozone monitoring station in the Imperial Valley. This was located at El Centro, but its specific location was changed to a new site beginning in 1986. In addition, there were no ozone data reported for 1984. Table 6-1 lists the number of state exceedance days at the El Centro sites.

Table 6-1. Imperial County Ozone Exceedances

| Number of Days with Maximum Ozone > 9 pphm | | | | |
|---|---|---|---|---|
| Site Name | Site Number | Years of Operation* | Total | Average Per Year |
| El Centro | 13685 | 1980-1983, 1985 | 50 | 10 |
| El Centro | 13694 | 1986-1989 | 21 | 5 |

* Note that monitoring did not always start in January. Ozone data for July through September available if listed, at a minimum.

The primary source of hourly meteorological data was the airport weather station at Imperial, California which is about 5 km northwest of El Centro. Hourly data were generally recorded from 0500 PST to 2100 PST at that location. Data from the El Centro ozone monitor and the Imperial Airport provided the basis for the analyses in this section.

This section discusses the characteristics and sources of the ozone and visibility occurrences in the Imperial Valley, including the relative importance of local sources compared with the effects of transport from Mexican areas such as Mexicali, about 15 to 20 km southeast of El Centro.

## 6.1 METEOROLOGICAL BACKGROUND

Wind directions at Imperial Airport are predominantly from the east to southeast during the day. This flow usually becomes more organized in the afternoon after 1200 PST. There is a slight trend toward a more southeasterly direction in the late afternoon. About 60 to 70% of the wind directions during the daytime are from a northeast to south direction. About 10% of the winds come from a southerly to westerly direction, while 5 to 10% of the winds are from the west to northeast. Calms make up the remainder of the wind frequencies and are most prevalent during the night and forenoon.

This flow pattern was well illustrated in a tracer release on August 11, 1981 during an ARB field study (Smith, et al., 1983). Tracer was released from Brawley (about 20 km north of El Centro) between 0500 and 0700 PST. The net transport of the tracer during the morning was minimal, but the material began to move toward the northwest (away from El Centro) by noon. The tracer reached Anza-Borrego in the evening and a portion arrived in Indio the following morning.

Another important feature of the regional meteorology of the Imperial Valley is the frequent occurrence of moisture surges moving into the area from the southeast.

## 6.2 MONTHLY AND ANNUAL OZONE VARIATIONS

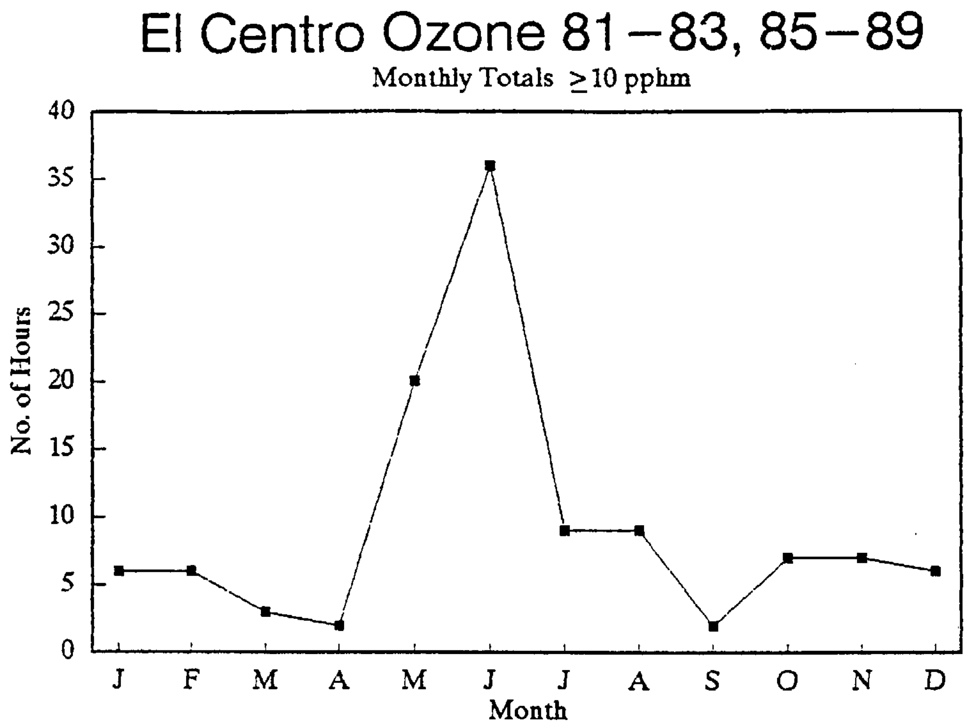
Figure 6-1 gives the monthly totals of ozone exceedance hours (≥10 pphm) for ozone at El Centro and the total hours per month when the visibility at Imperial Airport was five miles or less (0500 to 2100 PST). Visibility restrictions (reported by the National Weather Service) can occur for several reasons: haze, fog, or rain, and blowing dust (sand). The data plotted in Figure 6-1 only refer to haze restrictions. Although the observer might confuse fog and haze, eliminating fog and blowing dust visibility restrictions provides the best estimate available of particulate loadings associated with pollutants.

Both ozone and haze restrictions peak in May and June. The sharp decrease from June to July in both cases may have a small meteorological component (increased vertical mixing), but is most likely to be the result of decreases in farming and human activities during the summer months. The number of cases of low visibility (≤5 miles) far exceeds the number of exceedances of the state ozone standard.

Figure 6-2 shows the year-to-year variations in the May and June monthly total hours for both high ozone and low visibility. It is apparent that there is considerable correlation between the May and June totals, particularly in the visibility plot. The factors which contribute to the marked year-to-year variability are seasonal, yearly, or source-dependent, not monthly.

A notable feature of Figure 6-2 is the relatively small correlation between ozone and low visibility episodes. Peak years for low visibility episodes were 1981 and 1984. No ozone data are available for 1984; however, the peak ozone occurrences were reported in 1985 when low visibility was infrequent. Only about one third of the days with ozone concentrations of 10 pphm or more also experienced visibilities of 5 miles or less.

Figure 6-1 shows the total May and June hours per year and Table 6-2 the total May and June days per year with stated visibility and ozone conditions, but there is little apparent relation between ozone exceedances and visibility restrictions in either of the two.



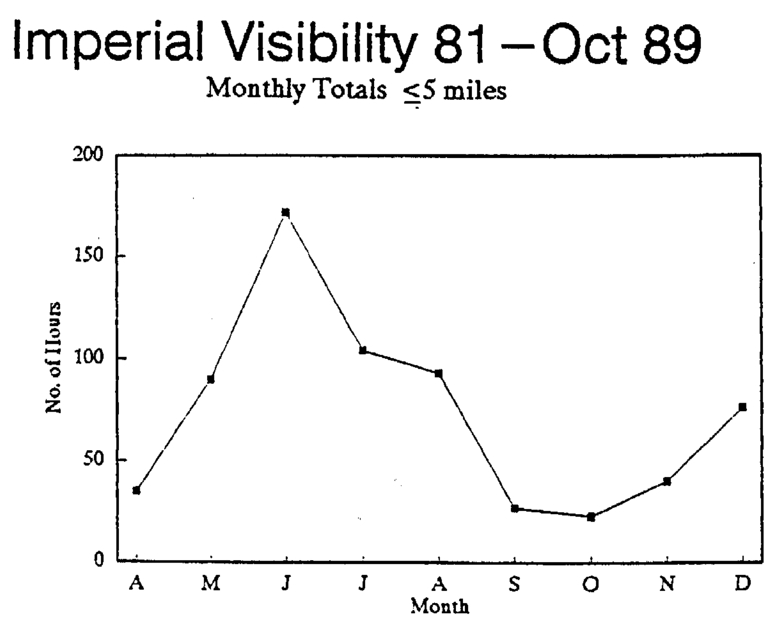
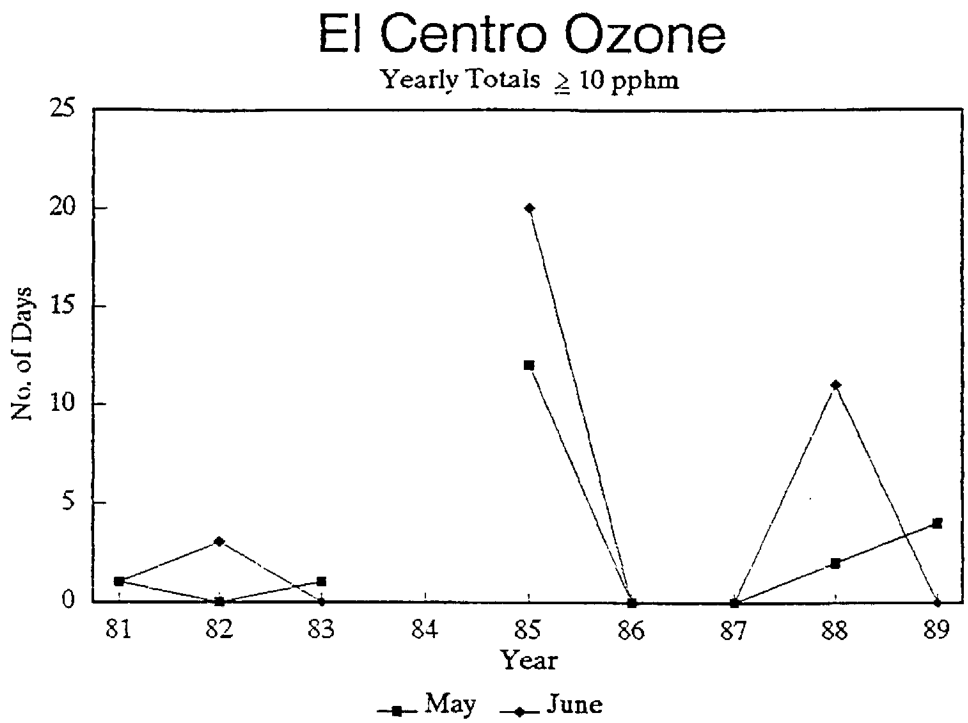




Figure 6-1. Monthly Frequency of State Ozone Exceedance Hours at El Centro and Low Visibility Hours at Imperial. Data for January, February, and March were not available.



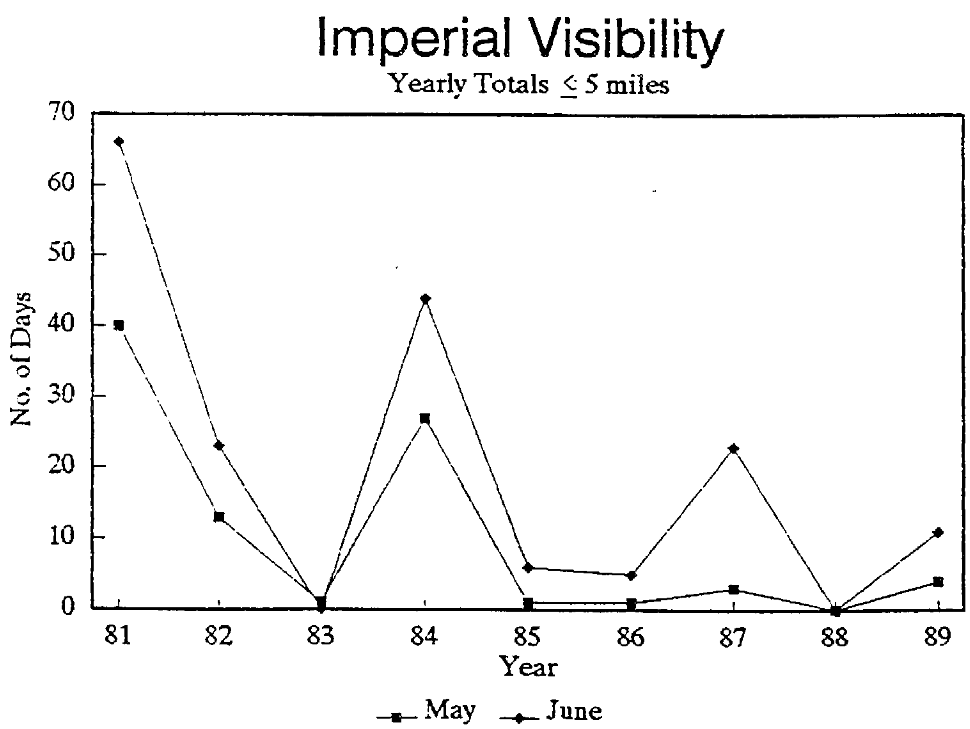




Figure 6-2. Frequency of State Ozone Exceedance Days at El Centro and Low Visibility Days at Imperial During May and June.

The year-to-year variability indicated in Figure 6-2 suggested a possible meteorological effect. The customary meteorological parameters to explore are the 850 mb temperature (available from Loyola-Marymount) and the pressure gradient from the coast into the desert (in this case, the San Diego-Las Vegas gradient at 0700 PST). Correlations between these two parameters and peak daily ozone concentrations at El Centro were calculated for all days in the combined May to June period (1982-89). The 850 mb temperature correlated with ozone at a level of 0.20, while the correlation between the morning pressure gradient and El Centro peak ozone concentrations was -0.12. Both correlations were too weak to be significant.

Table 6-2 illustrates the limited correlation between high ozone and low visibility days.

Table 6-2. Comparison of High Ozone and Low Visibility Days

| | May (No. Days) | | | June (No. Days) | | |
|---|---|---|---|---|---|---|
| Year | Avg. 850T | Low Vsb | High $O_3$ | Avg. 850T | Low Vsb | High $O_3$ |
| 81 | 12.3°C | 10 | 1 | 21.6°C | 16 | 1 |
| 82 | 11.6 | 3 | 0 | 13.8 | 7 | 2 |
| 83 | 13.5 | 1 | 1 | 15.0 | 0 | 0 |
| 84 | 12.8 | 6 | -- | 17.0 | 11 | -- |
| 85 | 11.7 | 1 | 5 | 20.1 | 1 | 6 |
| 86 | 14.3 | 0 | 0 | 19.3 | 3 | 0 |
| 87 | 12.8 | 2 | 0 | 18.6 | 7 | 0 |

Mean 850 mb temperatures for each May and June are included in Table 6-2. There is no marked relationship to the number of days with high ozone or low visibility. June 1981 is of particular interest. The average 850 mb temperature for the month was the highest of the years included in the study, but the ozone days were quite low while the number of days with low visibility was higher than any other June. June 1981 was noteworthy in other areas of Southern California for relatively high ozone levels in response to the warm temperatures aloft. The low ozone concentrations at El Centro suggest low emission levels in the area. Differences in emission levels may also account for other year-to-year variations in ozone at El Centro and may contribute to the poor correlation with meteorological variables.

Visibility does not seem to be related to meteorological parameters (see Table 6-2). Morning humidity at Imperial Airport was also explored as a possible factor, but with mixed results. Examination of individual cases suggested two separate regimes. Low visibilities frequently occured with southeasterly winds accompanied by high levels of moisture. However, low visibility at Imperial also occured under dry conditions with calm or light northerly winds.

## 6.3 HOURLY VARIATIONS

Figure 6-3 shows the number of hours (January to December) when the ozone concentration at El Centro equaled or exceeded 10 pphm and when Imperial visibility was 5 miles or less, as a function of time of day. The ozone concentration at El Centro equals or exceeds 10 pphm most frequently at 1200 PST. The low visibility peak occurs at 1300 PST.

The El Centro ozone peak in Figure 6-3 is unusually sharp compared to similar plots at other locations. In most areas, diurnal ozone plots show flatter peaks, frequently broadened and displaced into the afternoon. The sharp El Centro peak suggests a local source close enough to the monitoring station that variations in transport wind speed do not appreciably affect the ozone peak time. There is a shoulder at 1500 PST in Figure 6-3 which suggests transport on a two-to-three hour time scale.

The plot of Imperial visibility in Figure 6-3 has a broader peak than the El Centro ozone plot. Peak frequencies occur from 1200 to 1500 PST before decreasing significantly. This suggests either a more distributed source of the visibility restriction than the high ozone concentration, or a contribution from a different source in the afternoon after 1500 PST.

Figure 6-4a contrasts the diurnal visibility characteristics for June and December at Imperial Airport. The frequency of visibility restrictions peaks at 1500 PST in December, two hours later than the June peak. But the daylight time shift accounts for a one-hour difference. There is a second peak at about 1800 PST in the June data, possibly due to transport.

Figure 6-4b gives the diurnal plots of total visibility occurrences for the three month period (May to July) during the years 1981, 1984, 1987 and 1989. Reference to Figure 6-2 indicates that these years, together with 1982, were the highest frequency of low visibility occurrences during the period 1981-89. Figure 6-4b shows a marked decrease in the relative importance of the 1200-1300 PST peak from 1981 to 1987. At the same time, the 1500-1600 PST peak more-nearly maintains its relative importance. An additional late peak from 1900-2000 PST is apparent in 1987. The magnitude of the peak frequencies decreases over the nine year period but possible meteorological differences between years have not been accounted for and may explain some of the apparent decrease.

Regardless of meteorological effects, the change in relative importance of the 1200-1300 versus the 1500-1600 PST peaks suggests that the local visibility influences have decreased with time, while the transported influences have continued about the same or only decreased slightly.

## 6.4 EPISODE WIND DIRECTIONS

Wind directions at Imperial Airport were tabulated for the beginning hour of each period when the El Centro ozone reached 10 pphm or the Imperial visibility was five miles or less. In the absence of better trajectory data, the wind direction during the first episode hour was considered to be an indicator of the transport direction for the ozone or particulate

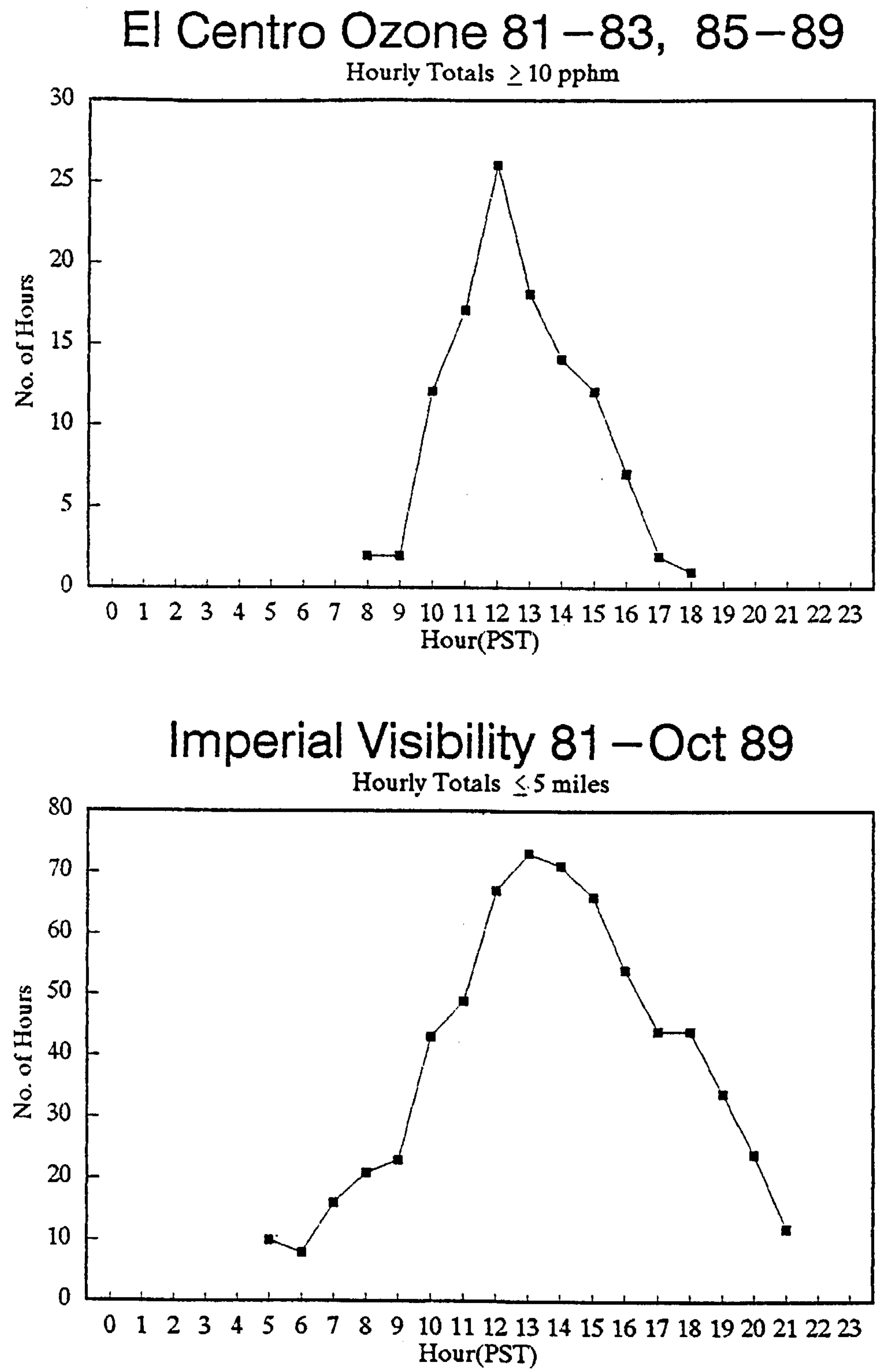
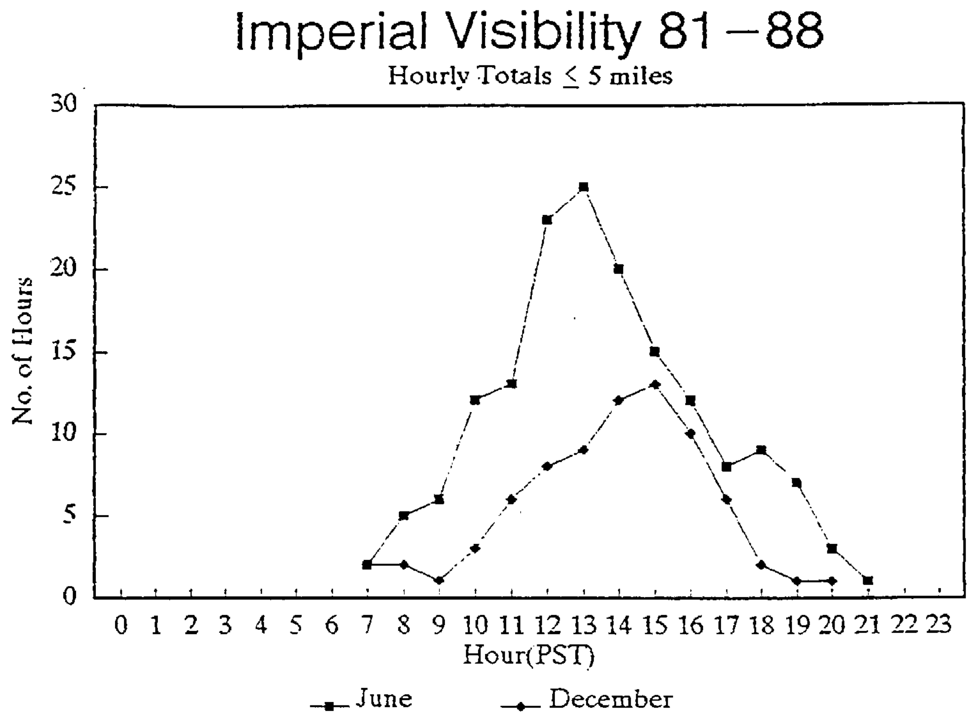
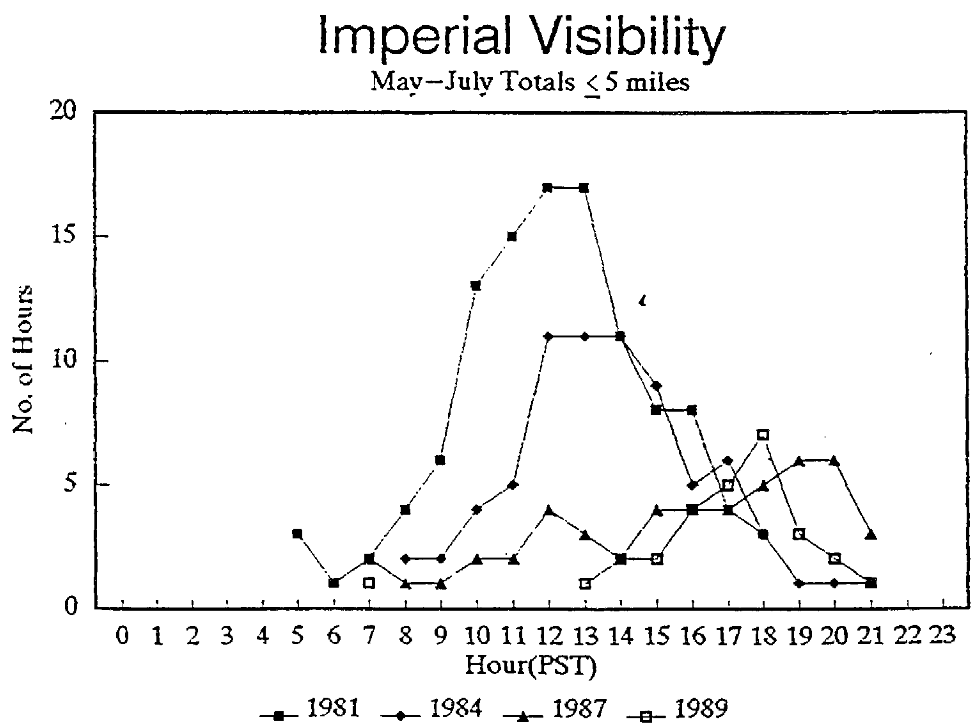



Figure 6-3. Diurnal Frequency of State Ozone Exceedance Hours at El Centro and Low Visibility Hours at Imperial.




(a)




(b)

Figure 6-4. Diurnal Frequency of Low Visibility Hours at Imperial for June and December (a) and for May-July 1981, 1984, 1987, and 1989 (b).

concentrations observed. These wind direction frequencies are given in Table 6-3 and are compared with 1200 PST direction frequencies for the April to December period. Visibility data for January, February, and March was not available, so only data for April to December was used. Direction categories were established at apparent break points in the data.

Table 6-3. Imperial Wind Direction Frequencies (April-December, 1981-89)

| | All Data | First Hour | |
|---|---|---|---|
| Direction | April-Dec. (1200 PST) | $O_3 \geq 10$ ppm | Visibility $\leq 5$ miles |
| 70-170° | 40.4% | 42.9% | 64.3% |
| 180-280 | 29.1 | 28.6 | 9.9 |
| 290- 60 | 19.8 | 12.2 | 9.9 |
| Calm | 10.7 | 16.3 | 15.9 |

Wind directions at 1200 PST are primarily from the east-to-south and secondarily from the southwest. The first hour frequencies on days with ozone $\geq$10 pphm are close to the overall 1200 PST frequencies, but with slightly lower occurrences of north-to-northwest winds and somewhat more calms. The first hour winds on days with visibilities $\leq$5 miles; however, show higher frequencies of east-to-south winds, a lower frequency of southwest winds and more calms than the overall distribution.

These comparisons indicate that the wind directions accompanying the appearance of high ozone concentrations do not come from a preferred direction, while those associated with the occurrence of low visibility come preferentially from the east to south. Calm conditions are favorable for both high ozone and low visibility conditions.

Table 6-4 examines the diurnal changes in east-to-south wind frequencies for those days when visibilities of 5 miles or less were observed at Imperial.

Table 6-4. Imperial Wind Direction Frequencies (1981-89)
Visibilities $\leq$5 Miles (April-December)

| Direction | 1000 PST | 1200 PST | 1400 PST | 1600 PST |
|---|---|---|---|---|
| 70-170° | 52.4% | 59.4% | 71.6% | 69.0% |
| 180-280 | 9.4 | 12.5 | 12.2 | 8.9 |
| 290- 60 | 17.0 | 13.1 | 8.8 | 7.1 |
| Calm | 21.2 | 15.0 | 7.4 | 15.2 |

The table shows a marked increase in the frequency of east-to-south winds in the afternoon. This appears to contribute to the displacement of the peak in the diurnal visibility curve into the afternoon. Table 6-4 also shows a sharp decrease in northerly winds from morning to afternoon, in contrast to the increase in east-to-south wind frequencies.

## 6.5 DISCUSSION OF TRANSPORT ISSUES

The foregoing sections have suggested that El Centro ozone concentrations result primarily from local sources without much apparent transport component. But visibility restrictions at Imperial Airport vary more widely in their time of occurrence and a transport contribution is indicated. The following paragraphs examine the time of the first hour of high ozone or low visibility in more detail in order to obtain more information on transport characteristics. It is a premise of the investigation that late-arriving pollutant peaks (1500 PST or later) are strongly suggestive of transport into the sampling area, while peaks arriving earlier are more suggestive of local influences.

### 6.5.1 Ozone Timing

During the period from 1981-1989 (1984 missing), there were 57 days with ozone concentrations at El Centro of 10 pphm or more. On 50 of the days, the ozone concentration had reached 10 pphm by 1400 PST. On the remaining seven days, the first state exceedance hour was 1500 or 1600 PST with one case of 1800 PST. The surface flow pattern on six of these days was from the east-to-southeast for at least two hours prior to the high ozone. In these cases, there could have been ozone or precursor transport into El Centro but on a limited basis in view of the light winds involved.

One of the late ozone occurrences at El Centro occurred on May 17, 1988. A value of 10 pphm was recorded at El Centro at 1600 PST. This concentration was preceded by 4 pphm at 1500 PST and followed by 3 pphm at 1700 PST. Imperial winds were from the southwest at 20-30 knots during and prior to the high ozone value. A premise for transport from San Diego County is not supported by peak ozone values in the County of 6 pphm on that day. No monitoring data were considered valid at El Centro prior to 1500 PST on May 17. It is concluded that the May 17, 1988 value of 10 pphm is probably not a valid reading.

The May 17 case is the only ozone occurrence which could be considered attributable to transport from San Diego County. The concentration of peak times at El Centro near 1200 PST precludes the hypothesis of same-day transport from San Diego County. This leaves the possibility of carry-over from the previous day, which is likely to be strongly dominated by local sources.

On the remaining 50 days, local sources are more likely to be responsible for the high ozone concentrations. On about half of the days with high ozone concentrations, the east-to-southeast flow had not begun by the time of the high ozone.

The high ozone and low visibility days were not particularly well correlated. On 20 of the 57 high ozone days, the minimum visibility was

5 miles or less, but the minimum visibility usually did not occur at the time of high ozone. On two of the high ozone days, the minimum visibility was 10 miles or more.

### 6.5.2 Visibility Timing

There were 182 days during the months of April to December (1981-89) when the visibility at Imperial Airport was reported to be 5 miles or less. This total excludes the hours when fog, rain, or blowing dust (sand) was recorded as a reason for the visibility restriction. Days with suspected transport into the area may be associated with the occurrence of low visibility late in the day. On 133 days, the first hour with visibility of 5 miles or less occurred between 1100 and 1400 PST. On 49 days, the first hour of low visibility occurred at 1500 PST or later. The latter days have been considered in more detail to determine their possible relation to transport scenarios.

On 44 of the 49 days with low visibility late in the day, the wind direction at the first hour of low visibility ($\leq$5 miles) was between 080° and 160° with an average velocity of about 11 knots. On the remaining five days, the first hour wind was from the southwest with an average velocity of six knots. On each of the five southwest days, the first hour of southwest winds was immediately preceded by one or more hours of winds from the southeast. The duration of the southeast flow prior to the first hour of low visibility ranged from 0 to 12 hours.

For the 133 days when the first hour of low visibility was between 1100 and 1400 PST, a southeast flow was established by the time of the start of the low visibility period on over half of the days. For the remaining days, the southeasterly flow was not initiated until after the low visibility period had started or was not initiated at all. Low visibilities on the latter days must result from more-local sources.

From the above comments it is apparent that over half of all the days with low visibility occur with southeasterly wind flow of varying duration. For the remaining days, light and variable winds were characteristic with a few cases of northwesterly flow. The duration of the southeasterly flow prior to the occurrence of low visibility varies widely. Many of the cases of low visibility are initiated within two hours of the establishment of southeasterly flow. This suggests source areas within 20-30 km of the Imperial Airport. This would include Calexico and Mexicali, but also might include contributions from the El Centro area.

Carry-over is a notable characteristic of low visibility conditions. Winds in the Valley decrease during the night and transport is considerably reduced. Low visibility conditions which exist in the late afternoon or early evening may tend to remain in the area overnight. Evidence of this scenario was present on 25 days during the 1981-89 period (April to December) when a low visibility day was immediately followed by another low visibility day, but with an earlier start time on the second day.

## 6.6 CONCLUSIONS

Based on our analyses, we made the following conclusions:

- Frequencies of high ozone concentrations and low visibility in the Imperial Valley peak in June, with a sharp reduction in July.
- Diurnal frequency peaks occur at 1200 PST for high ozone ($\geq$10 pphm) and at 1300 PST for low visibility. The diurnal curve for ozone is peaked very sharply at 1200 PST, while the low visibility peak is broader and extends into the afternoon.
- Wind direction frequencies for high ozone days are similar to the overall distribution of wind directions at 1200 PST. Direction frequencies for low visibility days show a predominant southeasterly flow.
- The analysis suggests that ozone is primarily a local problem with little evidence of transport into the area.

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# APPENDIX A

## OZONE EXCEEDANCE DAYS AT UPPER SACRAMENTO VALLEY MONITORING SITES (1980-1989)

For state ozone exceedances at Upper Sacramento Valley monitoring sites, plus Yuba City and Pleasant Grove, the following tables list the exceedance dates (Date), the maximum ozone concentration in pphm (Max), the hour of the first occurrence of the maximum (Hour), the number of hours of the maximum (Count), and the hourly ozone concentrations for each hour that day. The monitoring sites include the following:

| Site # | Site Name |
|---|---|
| 04628 | Chico (1980-1989) |
| 06643 | Colusa (1980-1987) |
| 06645 | Arbuckle (1984-1987) |
| 11673 | Willows (1980-1987) |
| 45560 | Redding (1980-1984) |
| 45558 | Anderson (1987-1988) |
| 45564 | Redding (1985-1989) |
| 51895 | Yuba City (1982-1989) |
| 51897 | Pleasant Grove (1982-1989) |
| 57574 | Dunnigans Rest (1982-1984) |

## Ozone Exceedence Days

## 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4628 | 800719 | 10 | 12 | 1 | 1 | 1 | 1 | 99 | 0 | 0 | 1 | 1 | 2 | 4 | 5 | 7 | 10 | 8 | 7 | 6 | 6 | 6 | 5 | 4 | 4 | 4 | 5 | 4 |
| 4628 | 800926 | 10 | 16 | 1 | 2 | 2 | 99 | 99 | 1 | 1 | 0 | 0 | 2 | 3 | 4 | 5 | 6 | 7 | 7 | 8 | 10 | 8 | 5 | 3 | 6 | 6 | 6 | 5 |
| 4628 | 801005 | 10 | 15 | 1 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 4 | 4 | 5 | 5 | 8 | 10 | 8 | 6 | 5 | 6 | 5 | 5 | 5 | 2 |
| 4628 | 801024 | 11 | 15 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 4 | 6 | 8 | 10 | 11 | 8 | 7 | 7 | 6 | 5 | 2 | 2 | 1 |
| 4628 | 810629 | 10 | 18 | 1 | 3 | 3 | 3 | 2 | 99 | 1 | 1 | 2 | 2 | 3 | 5 | 5 | 5 | 5 | 5 | 6 | 8 | 9 | 10 | 8 | 9 | 8 | 5 | 6 |
| 4628 | 850617 | 10 | 19 | 1 | 99 | 99 | 3 | 2 | 2 | 2 | 99 | 4 | 4 | 5 | 6 | 7 | 7 | 7 | 8 | 8 | 9 | 9 | 9 | 10 | 8 | 8 | 6 | 5 |
| 4628 | 850621 | 10 | 15 | 4 | 99 | 99 | 3 | 3 | 2 | 1 | 2 | 4 | 5 | 7 | 8 | 8 | 8 | 9 | 9 | 10 | 10 | 10 | 10 | 9 | 8 | 7 | 5 | 4 |
| 4628 | 850627 | 10 | 13 | 1 | 99 | 99 | 7 | 4 | 2 | 3 | 2 | 2 | 3 | 6 | 7 | 8 | 9 | 10 | 9 | 8 | 8 | 8 | 8 | 7 | 8 | 7 | 7 | 7 |
| 4628 | 850718 | 10 | 14 | 1 | 99 | 99 | 4 | 4 | 1 | 1 | 3 | 4 | 5 | 6 | 7 | 7 | 8 | 9 | 10 | 9 | 9 | 8 | 7 | 6 | 5 | 5 | 6 | 6 |
| 4628 | 860721 | 11 | 17 | 1 | 99 | 99 | 3 | 2 | 2 | 2 | 1 | 4 | 6 | 6 | 99 | 7 | 8 | 8 | 8 | 8 | 9 | 11 | 8 | 8 | 8 | 9 | 9 | 7 |
| 4628 | 861016 | 10 | 14 | 1 | 99 | 99 | 3 | 0 | 0 | 1 | 0 | 0 | 2 | 4 | 4 | 4 | 6 | 9 | 10 | 8 | 7 | 5 | 4 | 4 | 3 | 3 | 2 | 2 |
| 4628 | 870603 | 11 | 18 | 1 | 99 | 99 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 6 | 7 | 7 | 7 | 8 | 9 | 8 | 8 | 10 | 11 | 9 | 8 | 7 | 6 | 5 |
| 4628 | 870626 | 10 | 17 | 1 | 99 | 99 | 4 | 4 | 3 | 1 | 2 | 4 | 5 | 5 | 7 | 7 | 9 | 9 | 8 | 8 | 8 | 10 | 9 | 8 | 9 | 7 | 5 | 3 |
| 4628 | 870807 | 10 | 17 | 1 | 99 | 99 | 3 | 3 | 1 | 1 | 1 | 2 | 3 | 5 | 6 | 6 | 7 | 7 | 7 | 8 | 9 | 10 | 9 | 7 | 7 | 6 | 6 | 6 |
| 4628 | 870826 | 10 | 17 | 1 | 99 | 99 | 3 | 3 | 1 | 0 | 1 | 2 | 3 | 5 | 6 | 7 | 7 | 8 | 8 | 8 | 8 | 10 | 8 | 7 | 7 | 5 | 5 | 4 |
| 4628 | 870922 | 10 | 19 | 1 | 99 | 99 | 4 | 2 | 1 | 2 | 0 | 1 | 1 | 4 | 5 | 6 | 7 | 8 | 8 | 8 | 9 | 9 | 8 | 10 | 9 | 7 | 4 | 3 |
| 4628 | 880720 | 10 | 20 | 1 | 2 | 2 | 1 | 1 | 99 | 99 | 99 | 99 | 99 | 99 | 6 | 7 | 99 | 99 | 99 | 7 | 7 | 8 | 9 | 8 | 10 | 8 | 6 | 4 |
| 4628 | 880721 | 10 | 12 | 1 | 4 | 4 | 4 | 3 | 99 | 99 | 2 | 2 | 3 | 5 | 7 | 9 | 10 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 6 |
| 4628 | 880722 | 10 | 13 | 3 | 4 | 4 | 4 | 4 | 99 | 99 | 2 | 3 | 4 | 6 | 7 | 8 | 9 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 7 | 7 | 8 | 8 |
| 4628 | 880723 | 10 | 16 | 1 | 6 | 4 | 4 | 4 | 99 | 99 | 3 | 3 | 5 | 6 | 7 | 8 | 9 | 9 | 9 | 9 | 10 | 9 | 9 | 9 | 8 | 7 | 7 | 6 |
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| 4628 | 880830 | 10 | 11 | 1 | 4 | 3 | 3 | 3 | 99 | 5 | 3 | 1 | 4 | 6 | 7 | 10 | 8 | 8 | 8 | 9 | 9 | 8 | 7 | 6 | 6 | 6 | 5 | 4 |
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| 4628 | 890410 | 10 | 15 | 1 | 3 | 3 | 2 | 1 | 99 | 1 | 0 | 99 | 3 | 4 | 5 | 6 | 6 | 7 | 9 | 10 | 7 | 6 | 4 | 4 | 4 | 2 | 1 | 1 |
| 4628 | 890415 | 10 | 17 | 1 | 3 | 3 | 3 | 2 | 99 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 6 | 8 | 8 | 8 | 8 | 10 | 8 | 7 | 6 | 5 | 5 | 4 |
| 4628 | 890728 | 10 | 17 | 1 | 6 | 6 | 5 | 99 | 99 | 5 | 1 | 3 | 5 | 7 | 8 | 9 | 9 | 8 | 8 | 9 | 9 | 10 | 8 | 7 | 7 | 7 | 6 | 5 |
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# Ozone Exceedence Days

## 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
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| 6643 | 800925 | 11 | 14 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 4 | 6 | 8 | 9 | 10 | 11 | 10 | 9 | 7 | 7 | 6 | 3 | 3 | 2 | 2 |
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| 6643 | 801011 | 11 | 16 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 6 | 7 | 8 | 11 | 7 | 4 | 2 | 2 | 2 | 2 | 2 |
| 6643 | 801101 | 10 | 15 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 4 | 4 | 5 | 4 | 6 | 10 | 8 | 7 | 8 | 7 | 6 | 6 | 99 | 99 |
| 6643 | 810625 | 10 | 17 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 4 | 4 | 8 | 9 | 8 | 8 | 8 | 8 | 9 | 10 | 7 | 5 | 6 | 5 | 4 | 3 |
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| 6643 | 810710 | 10 | 17 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 5 | 6 | 7 | 8 | 8 | 9 | 9 | 10 | 9 | 6 | 4 | 3 | 3 | 2 |
| 6643 | 810717 | 10 | 17 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 4 | 7 | 7 | 7 | 7 | 8 | 8 | 10 | 7 | 6 | 4 | 3 | 2 | 1 |
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| 6643 | 840716 | 11 | 16 | 1 | 4 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 3 | 99 | 99 | 8 | 8 | 9 | 9 | 9 | 11 | 10 | 9 | 7 | 7 | 6 | 5 | 4 |
| 6643 | 840717 | 10 | 15 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 5 | 6 | 6 | 8 | 10 | 10 | 9 | 8 | 7 | 4 | 3 | 3 | 4 |
| 6643 | 840718 | 11 | 13 | 1 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | 3 | 4 | 3 | 6 | 8 | 9 | 11 | 10 | 9 | 10 | 10 | 8 | 6 | 3 | 4 | 2 | 3 |
| 6643 | 850621 | 10 | 16 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 5 | 6 | 99 | 99 | 9 | 9 | 9 | 10 | 8 | 6 | 5 | 3 | 2 | 2 | 2 |
| 6643 | 850627 | 10 | 16 | 1 | 99 | 3 | 4 | 4 | 4 | 3 | 3 | 4 | 6 | 7 | 7 | 7 | 8 | 8 | 9 | 9 | 10 | 9 | 6 | 5 | 4 | 4 | 3 | 4 |
| 6643 | 850816 | 10 | 15 | 1 | 99 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 8 | 10 | 8 | 8 | 8 | 6 | 3 | 1 | 1 | 1 |
| 6643 | 851005 | 10 | 13 | 4 | 99 | 1 | 1 | 0 | 2 | 1 | 0 | 2 | 4 | 6 | 8 | 8 | 9 | 10 | 10 | 10 | 10 | 8 | 6 | 6 | 6 | 5 | 5 | 3 |
| 6643 | 860623 | 10 | 15 | 1 | 2 | 99 | 2 | 2 | 2 | 2 | 2 | 4 | 6 | 7 | 8 | 8 | 8 | 8 | 9 | 10 | 9 | 9 | 8 | 6 | 6 | 4 | 4 | 3 |
| 6643 | 860721 | 11 | 17 | 1 | 1 | 99 | 99 | 1 | 0 | 0 | 2 | 2 | 4 | 6 | 7 | 7 | 8 | 8 | 9 | 9 | 9 | 11 | 7 | 5 | 5 | 5 | 4 | 4 |
| 6643 | 860820 | 10 | 14 | 3 | 3 | 99 | 1 | 1 | 2 | 0 | 1 | 3 | 5 | 6 | 7 | 7 | 8 | 9 | 10 | 10 | 10 | 8 | 6 | 5 | 5 | 4 | 3 | 2 |
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| 6643 | 860904 | 10 | 15 | 2 | 0 | 99 | 99 | 99 | 99 | 99 | 99 | 0 | 1 | 2 | 3 | 5 | 7 | 9 | 9 | 10 | 10 | 9 | 8 | 7 | 5 | 3 | 2 | 1 |
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| 6643 | 870626 | 10 | 15 | 3 | 3 | 99 | 3 | 2 | 2 | 2 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 9 | 10 | 10 | 10 | 7 | 6 | 4 | 3 | 2 | 2 |
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# Ozone Exceedence Days

# 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6645 | 840706 | 10 | 14 | 2 | 1 | 1 | 0 | 0 | 99 | 0 | 1 | 2 | 3 | 5 | 8 | 8 | 8 | 9 | 10 | 10 | 9 | 8 | 8 | 6 | 4 | 3 | 1 | 0 |
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| 6645 | 840727 | 10 | 13 | 2 | 1 | 1 | 1 | 99 | 99 | 1 | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 5 | 4 | 2 | 1 |
| 6645 | 840809 | 11 | 15 | 1 | 1 | 0 | 1 | 0 | 99 | 0 | 1 | 2 | 4 | 6 | 7 | 7 | 8 | 8 | 8 | 11 | 6 | 5 | 4 | 4 | 4 | 4 | 4 | 4 |
| 6645 | 840925 | 10 | 16 | 1 | 2 | 2 | 2 | 99 | 2 | 2 | 2 | 2 | 2 | 99 | 99 | 99 | 6 | 8 | 8 | 9 | 10 | 7 | 5 | 6 | 6 | 6 | 5 | 4 |
| 6645 | 840926 | 10 | 16 | 1 | 2 | 3 | 3 | 99 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 4 | 5 | 6 | 7 | 9 | 10 | 6 | 5 | 6 | 6 | 6 | 5 | 5 |
| 6645 | 840927 | 10 | 14 | 1 | 2 | 4 | 5 | 99 | 3 | 3 | 3 | 2 | 4 | 4 | 4 | 99 | 5 | 9 | 10 | 8 | 7 | 7 | 5 | 5 | 6 | 6 | 5 | 4 |
| 6645 | 850618 | 11 | 17 | 1 | 2 | 99 | 2 | 1 | 2 | 2 | 2 | 2 | 4 | 5 | 6 | 7 | 8 | 8 | 9 | 9 | 10 | 11 | 9 | 6 | 4 | 1 | 1 | 1 |
| 6645 | 850824 | 10 | 17 | 1 | 1 | 99 | 1 | 1 | 0 | 0 | 1 | 2 | 4 | 5 | 7 | 8 | 9 | 9 | 9 | 9 | 9 | 10 | 6 | 4 | 4 | 4 | 3 | 1 |
| 6645 | 851005 | 10 | 15 | 1 | 0 | 99 | 2 | 1 | 1 | 1 | 1 | 2 | 5 | 6 | 7 | 8 | 8 | 9 | 9 | 10 | 9 | 8 | 7 | 5 | 5 | 4 | 3 | 1 |
| 6645 | 851018 | 10 | 15 | 1 | 2 | 99 | 1 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 4 | 5 | 5 | 9 | 10 | 8 | 6 | 4 | 4 | 4 | 3 | 0 | 0 |
| 6645 | 860730 | 10 | 18 | 1 | 2 | 99 | 1 | 2 | 1 | 3 | 3 | 4 | 5 | 5 | 5 | 5 | 7 | 8 | 7 | 7 | 7 | 8 | 10 | 7 | 5 | 4 | 3 | 2 |
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| 6645 | 860906 | 10 | 14 | 1 | 0 | 99 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 5 | 6 | 7 | 8 | 10 | 8 | 9 | 8 | 7 | 5 | 2 | 1 | 1 | 1 |
| 6645 | 870603 | 12 | 13 | 3 | 8 | 99 | 2 | 3 | 1 | 1 | 1 | 3 | 99 | 7 | 8 | 10 | 11 | 12 | 12 | 12 | 9 | 8 | 6 | 5 | 5 | 5 | 6 | 3 |
| 6645 | 870619 | 10 | 15 | 3 | 2 | 99 | 1 | 1 | 0 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 9 | 9 | 10 | 10 | 10 | 7 | 5 | 4 | 3 | 2 | 2 |
| 6645 | 870625 | 10 | 14 | 4 | 5 | 99 | 2 | 2 | 0 | 1 | 2 | 4 | 5 | 7 | 8 | 9 | 9 | 9 | 10 | 10 | 10 | 10 | 9 | 7 | 7 | 7 | 7 | 7 |
| 6645 | 870626 | 11 | 13 | 3 | 5 | 99 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 4 | 6 | 8 | 10 | 11 | 11 | 11 | 10 | 8 | 6 | 4 | 4 | 2 | 2 | 1 |
| 6645 | 870714 | 10 | 13 | 4 | 0 | 99 | 0 | 0 | 0 | 0 | 1 | 2 | 4 | 5 | 7 | 8 | 9 | 10 | 10 | 10 | 10 | 9 | 6 | 5 | 3 | 1 | 1 | 1 |
| 6645 | 870801 | 10 | 17 | 1 | 3 | 99 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 6 | 6 | 6 | 7 | 7 | 8 | 8 | 9 | 10 | 9 | 8 | 7 | 7 | 5 | 5 |
| 6645 | 870803 | 12 | 17 | 1 | 8 | 99 | 4 | 5 | 2 | 1 | 3 | 4 | 6 | 6 | 8 | 9 | 10 | 10 | 9 | 9 | 11 | 12 | 8 | 7 | 7 | 6 | 4 | 0 |
| 6645 | 870804 | 10 | 16 | 2 | 1 | 99 | 1 | 0 | 0 | 1 | 2 | 3 | 3 | 5 | 6 | 8 | 9 | 9 | 9 | 9 | 10 | 10 | 9 | 5 | 4 | 2 | 1 | 0 |
| 6645 | 870806 | 10 | 15 | 3 | 1 | 99 | 0 | 0 | 0 | 0 | 1 | 3 | 4 | 6 | 7 | 8 | 9 | 8 | 8 | 10 | 10 | 10 | 8 | 6 | 3 | 2 | 1 | 1 |
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| 6645 | 870808 | 10 | 15 | 1 | 0 | 99 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 8 | 9 | 10 | 9 | 7 | 6 | 6 | 5 | 5 | 3 | 1 |
| 6645 | 870818 | 10 | 15 | 1 | 0 | 99 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 5 | 8 | 8 | 9 | 10 | 8 | 7 | 5 | 3 | 2 | 2 | 2 | 2 |
| 6645 | 870821 | 10 | 16 | 2 | 0 | 99 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 9 | 10 | 10 | 9 | 7 | 6 | 6 | 5 | 2 |
| 6645 | 870826 | 10 | 12 | 2 | 1 | 99 | 1 | 0 | 0 | 0 | 1 | 1 | 2 | 3 | 3 | 5 | 10 | 9 | 9 | 10 | 9 | 8 | 7 | 4 | 2 | 1 | 1 | 1 |
| 6645 | 870901 | 10 | 15 | 2 | 3 | 99 | 1 | 0 | 0 | 1 | 1 | 2 | 1 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 10 | 9 | 8 | 8 | 7 | 5 | 3 | 4 |
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| 6645 | 871014 | 10 | 15 | 1 | 1 | 99 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 4 | 6 | 7 | 8 | 9 | 10 | 9 | 7 | 6 | 6 | 5 | 4 | 4 | 3 |
| 6645 | 871015 | 10 | 13 | 3 | 3 | 99 | 3 | 3 | 3 | 3 | 3 | 3 | 6 | 6 | 7 | 9 | 9 | 10 | 10 | 10 | 9 | 8 | 6 | 6 | 6 | 7 | 7 | 5 |
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# Ozone Exceedence Days

# 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
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| 11673 | 800503 | 10 | 12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 10 | 9 | 8 | 8 | 8 | 8 | 8 | 7 | 6 | 4 | 4 | 2 |
| 11673 | 800618 | 10 | 15 | 3 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 5 | 8 | 7 | 8 | 8 | 9 | 10 | 10 | 9 | 10 | 7 | 4 | 4 | 3 | 2 |
| 11673 | 800810 | 10 | 14 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 4 | 5 | 6 | 6 | 6 | 7 | 9 | 10 | 8 | 8 | 7 | 6 | 5 | 3 | 0 | 1 | 2 |
| 11673 | 800926 | 10 | 14 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 5 | 7 | 8 | 9 | 10 | 10 | 8 | 9 | 6 | 3 | 2 | 1 | 1 | 2 |
| 11673 | 800929 | 12 | 16 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 12 | 8 | 3 | 1 | 2 | 2 | 2 | 2 |
| 11673 | 801005 | 11 | 12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 5 | 7 | 11 | 9 | 8 | 8 | 8 | 5 | 1 | 1 | 2 | 1 | 2 | 3 |
| 11673 | 810901 | 10 | 16 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 5 | 5 | 5 | 7 | 8 | 9 | 10 | 9 | 7 | 6 | 3 | 1 | 2 | 2 |
| 11673 | 820722 | 10 | 15 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 4 | 5 | 6 | 7 | 7 | 8 | 9 | 10 | 9 | 7 | 7 | 4 | 0 | 0 | 0 | 1 |
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| 11673 | 840711 | 10 | 14 | 2 | 2 | 2 | 2 | 2 | 0 | 0 | 1 | 3 | 5 | 7 | 7 | 8 | 8 | 9 | 10 | 9 | 10 | 9 | 8 | 5 | 2 | 0 | 1 | 1 |
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| 11673 | 850621 | 10 | 14 | 2 | 99 | 3 | 3 | 1 | 1 | 2 | 3 | 5 | 5 | 5 | 6 | 8 | 9 | 9 | 10 | 10 | 9 | 9 | 8 | 6 | 3 | 3 | 3 | 2 |
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| 11673 | 860613 | 10 | 16 | 1 | 99 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 6 | 7 | 8 | 9 | 10 | 8 | 6 | 5 | 4 | 3 | 2 | 2 |
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| 11673 | 870625 | 10 | 11 | 2 | 99 | 0 | 0 | 0 | 0 | 1 | 2 | 5 | 5 | 8 | 9 | 10 | 10 | 9 | 9 | 8 | 9 | 8 | 7 | 6 | 6 | 2 | 2 | 3 |
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| 11673 | 870818 | 10 | 15 | 2 | 99 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 10 | 8 | 6 | 4 | 3 | 2 | 1 | 1 |
| 11673 | 870902 | 10 | 15 | 2 | 99 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 6 | 8 | 8 | 8 | 9 | 9 | 10 | 10 | 9 | 6 | 3 | 0 | 0 | 0 | 0 |
| 11673 | 870919 | 11 | 15 | 2 | 99 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 5 | 6 | 7 | 8 | 9 | 10 | 10 | 11 | 11 | 9 | 5 | 3 | 0 | 1 | 0 | 0 |
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# Ozone Exceedence Days

# 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45560 | 800520 | 10 | 14 | 4 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 6 | 8 | 9 | 9 | 10 | 10 | 10 | 10 | 9 | 7 | 5 | 5 | 4 | 5 |
| 45560 | 800618 | 10 | 14 | 2 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 7 | 9 | 8 | 9 | 10 | 10 | 9 | 9 | 9 | 8 | 6 | 3 | 5 | 6 |
| 45560 | 800619 | 10 | 11 | 4 | 5 | 5 | 6 | 4 | 3 | 2 | 2 | 3 | 5 | 7 | 9 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 9 | 8 | 5 | 7 |
| 45560 | 800629 | 10 | 13 | 1 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 5 | 6 | 8 | 8 | 9 | 9 | 10 | 9 | 4 | 8 | 8 | 7 | 7 | 5 | 4 | 3 | 5 |
| 45560 | 800701 | 10 | 11 | 1 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 7 | 8 | 9 | 10 | 9 | 8 | 7 | 7 | 8 | 7 | 5 | 5 | 5 | 4 | 5 | 4 |
| 45560 | 800718 | 10 | 12 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 5 | 6 | 7 | 8 | 10 | 9 | 10 | 10 | 10 | 10 | 8 | 6 | 3 | 3 | 3 | 5 |
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| 45560 | 800729 | 10 | 12 | 2 | 7 | 6 | 6 | 6 | 6 | 5 | 5 | 6 | 8 | 9 | 9 | 9 | 10 | 10 | 9 | 8 | 7 | 7 | 6 | 5 | 6 | 5 | 5 | 5 |
| 45560 | 800730 | 10 | 10 | 1 | 6 | 4 | 5 | 4 | 4 | 3 | 4 | 5 | 6 | 8 | 10 | 9 | 9 | 9 | 8 | 8 | 7 | 6 | 6 | 7 | 7 | 8 | 8 | 6 |
| 45560 | 800804 | 10 | 14 | 2 | 4 | 4 | 4 | 4 | 3 | 1 | 1 | 2 | 5 | 6 | 8 | 9 | 9 | 9 | 10 | 10 | 9 | 7 | 6 | 6 | 6 | 6 | 6 | 7 |
| 45560 | 800806 | 10 | 10 | 6 | 5 | 4 | 5 | 3 | 3 | 1 | 2 | 3 | 5 | 7 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 7 | 7 | 6 | 3 | 4 | 6 |
| 45560 | 800808 | 10 | 15 | 1 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 6 | 7 | 8 | 7 | 8 | 9 | 9 | 10 | 9 | 8 | 7 | 4 | 2 | 3 | 5 | 5 |
| 45560 | 800809 | 10 | 11 | 4 | 6 | 5 | 6 | 5 | 5 | 5 | 5 | 5 | 6 | 7 | 8 | 10 | 10 | 9 | 10 | 10 | 9 | 9 | 6 | 5 | 4 | 6 | 6 | 6 |
| 45560 | 800810 | 10 | 10 | 3 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 8 | 10 | 10 | 8 | 9 | 9 | 10 | 9 | 9 | 8 | 6 | 3 | 5 | 6 | 6 |
| 45560 | 800811 | 10 | 13 | 5 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 6 | 8 | 9 | 9 | 10 | 10 | 10 | 10 | 10 | 8 | 7 | 5 | 3 | 3 | 5 |
| 45560 | 800813 | 10 | 16 | 2 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 6 | 8 | 8 | 8 | 9 | 9 | 9 | 10 | 10 | 9 | 7 | 6 | 6 | 6 | 6 |
| 45560 | 800814 | 10 | 17 | 1 | 5 | 5 | 4 | 4 | 4 | 3 | 2 | 2 | 3 | 4 | 5 | 7 | 8 | 8 | 8 | 8 | 9 | 10 | 9 | 7 | 6 | 6 | 7 | 4 |
| 45560 | 800926 | 11 | 17 | 1 | 4 | 4 | 3 | 4 | 3 | 3 | 2 | 3 | 3 | 3 | 5 | 8 | 9 | 10 | 8 | 7 | 9 | 11 | 7 | 3 | 4 | 6 | 6 | 6 |
| 45560 | 800927 | 10 | 11 | 2 | 5 | 5 | 5 | 5 | 2 | 2 | 1 | 2 | 4 | 5 | 7 | 10 | 10 | 8 | 8 | 8 | 6 | 5 | 3 | 1 | 1 | 2 | 2 | 2 |
| 45560 | 810703 | 11 | 11 | 2 | 3 | 3 | 4 | 3 | 3 | 3 | 4 | 5 | 6 | 8 | 9 | 11 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 5 | 4 | 5 | 5 |
| 45560 | 810704 | 10 | 10 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 7 | 9 | 10 | 10 | 9 | 9 | 10 | 9 | 9 | 8 | 7 | 6 | 5 | 5 | 5 | 5 |
| 45560 | 810716 | 10 | 11 | 1 | 3 | 4 | 3 | 2 | 2 | 2 | 3 | 3 | 5 | 6 | 8 | 10 | 9 | 9 | 8 | 6 | 6 | 6 | 6 | 4 | 3 | 2 | 2 | 5 |
| 45560 | 810717 | 11 | 11 | 1 | 5 | 5 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 6 | 8 | 11 | 10 | 9 | 8 | 7 | 7 | 7 | 6 | 5 | 3 | 3 | 3 | 4 |
| 45560 | 810718 | 11 | 11 | 2 | 5 | 4 | 4 | 4 | 4 | 2 | 4 | 4 | 5 | 7 | 9 | 11 | 9 | 11 | 9 | 9 | 8 | 8 | 7 | 5 | 3 | 5 | 5 | 5 |
| 45560 | 810727 | 10 | 12 | 1 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 4 | 6 | 8 | 9 | 10 | 8 | 9 | 8 | 8 | 8 | 7 | 6 | 4 | 3 | 2 | 3 |
| 45560 | 810728 | 10 | 10 | 2 | 5 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 6 | 8 | 10 | 9 | 9 | 10 | 9 | 8 | 8 | 7 | 7 | 6 | 3 | 2 | 2 | 3 |
| 45560 | 810806 | 10 | 11 | 4 | 4 | 3 | 4 | 4 | 3 | 3 | 3 | 4 | 5 | 7 | 9 | 10 | 10 | 10 | 10 | 8 | 7 | 9 | 7 | 5 | 3 | 3 | 4 | 5 |
| 45560 | 810808 | 10 | 10 | 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 4 | 6 | 8 | 10 | 8 | 9 | 9 | 7 | 7 | 7 | 9 | 8 | 5 | 3 | 3 | 4 | 4 |
| 45560 | 810809 | 11 | 13 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 4 | 6 | 8 | 8 | 10 | 10 | 11 | 11 | 10 | 9 | 8 | 8 | 6 | 4 | 3 | 3 | 5 |
| 45560 | 810810 | 10 | 11 | 4 | 5 | 5 | 4 | 4 | 2 | 1 | 2 | 2 | 5 | 7 | 9 | 10 | 10 | 10 | 10 | 9 | 8 | 7 | 7 | 6 | 6 | 6 | 5 | 3 |
| 45560 | 810811 | 10 | 12 | 2 | 4 | 4 | 5 | 3 | 2 | 1 | 1 | 3 | 4 | 6 | 8 | 9 | 10 | 9 | 9 | 10 | 9 | 9 | 8 | 7 | 7 | 6 | 5 | 6 |
| 45560 | 810812 | 10 | 12 | 4 | 5 | 4 | 4 | 4 | 2 | 2 | 2 | 3 | 5 | 7 | 8 | 9 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 | 6 | 5 | 4 | 3 |
| 45560 | 810908 | 10 | 12 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 2 | 2 | 4 | 6 | 8 | 9 | 10 | 10 | 10 | 10 | 8 | 8 | 6 | 4 | 2 | 2 | 4 | 6 |
| 45560 | 810909 | 11 | 15 | 1 | 6 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 5 | 7 | 8 | 9 | 9 | 9 | 9 | 11 | 9 | 9 | 9 | 6 | 5 | 3 | 4 | 5 |
| 45560 | 810912 | 11 | 11 | 3 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 5 | 5 | 7 | 10 | 11 | 11 | 9 | 11 | 9 | 9 | 10 | 9 | 9 | 5 | 4 | 5 | 4 |
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| 45560 | 810914 | 12 | 14 | 1 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 3 | 3 | 5 | 8 | 9 | 11 | 11 | 12 | 11 | 10 | 8 | 6 | 6 | 6 | 6 | 5 | 6 |
| 45560 | 810915 | 11 | 16 | 2 | 6 | 6 | 6 | 6 | 6 | 5 | 4 | 2 | 3 | 6 | 8 | 10 | 9 | 9 | 10 | 9 | 11 | 11 | 10 | 5 | 5 | 4 | 4 | 5 |
| 45560 | 810916 | 11 | 13 | 1 | 5 | 5 | 6 | 5 | 2 | 2 | 2 | 3 | 4 | 6 | 8 | 10 | 10 | 11 | 10 | 9 | 9 | 10 | 9 | 8 | 5 | 5 | 4 | 5 |
| 45560 | 810917 | 10 | 12 | 1 | 5 | 5 | 5 | 5 | 3 | 2 | 1 | 2 | 3 | 5 | 7 | 9 | 10 | 8 | 9 | 9 | 7 | 7 | 4 | 5 | 2 | 1 | 4 | 5 |
| 45560 | 810918 | 10 | 17 | 1 | 5 | 5 | 5 | 5 | 4 | 4 | 3 | 3 | 4 | 5 | 6 | 7 | 9 | 9 | 8 | 9 | 9 | 10 | 9 | 3 | 3 | 2 | 2 | 2 |
| 45560 | 820619 | 10 | 14 | 1 | 4 | 5 | 5 | 5 | 4 | 3 | 1 | 2 | 2 | 3 | 5 | 5 | 6 | 6 | 10 | 9 | 8 | 8 | 7 | 5 | 4 | 4 | 5 | 4 |
| 45560 | 820719 | 10 | 11 | 2 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 6 | 6 | 8 | 10 | 10 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 2 | 2 | 4 | 5 |
| 45560 | 820823 | 10 | 11 | 2 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 5 | 7 | 9 | 10 | 8 | 10 | 9 | 9 | 8 | 7 | 6 | 5 | 4 | 2 | 2 | 4 |

Ozone Exceedence Days 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45560 | 820824 | 10 | 11 | 2 | 4 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 5 | 7 | 9 | 10 | 9 | 9 | 10 | 9 | 9 | 8 | 7 | 5 | 3 | 3 | 2 | 4 |
| 45560 | 820825 | 10 | 11 | 1 | 4 | 4 | 3 | 3 | 2 | 1 | 0 | 1 | 3 | 5 | 8 | 10 | 9 | 9 | 9 | 8 | 7 | 6 | 5 | 6 | 4 | 3 | 4 | 4 |
| 45560 | 830524 | 10 | 12 | 1 | 4 | 4 | 4 | 4 | 4 | 99 | 3 | 4 | 5 | 6 | 7 | 9 | 10 | 8 | 8 | 7 | 7 | 6 | 6 | 4 | 2 | 4 | 4 | 4 |
| 45560 | 830525 | 10 | 12 | 1 | 4 | 4 | 3 | 3 | 3 | 99 | 3 | 3 | 4 | 6 | 7 | 8 | 10 | 9 | 9 | 7 | 7 | 6 | 5 | 4 | 1 | 2 | 3 | 4 |
| 45560 | 830526 | 10 | 12 | 1 | 4 | 4 | 4 | 4 | 4 | 99 | 3 | 3 | 5 | 7 | 8 | 9 | 10 | 9 | 9 | 8 | 7 | 7 | 6 | 4 | 3 | 4 | 4 | 5 |
| 45560 | 830527 | 10 | 13 | 3 | 4 | 3 | 3 | 3 | 3 | 99 | 2 | 3 | 4 | 5 | 7 | 9 | 9 | 10 | 9 | 10 | 9 | 10 | 9 | 3 | 3 | 4 | 5 | 5 |
| 45560 | 830723 | 10 | 12 | 1 | 5 | 5 | 5 | 5 | 5 | 99 | 4 | 5 | 6 | 8 | 9 | 9 | 10 | 9 | 8 | 8 | 8 | 8 | 8 | 7 | 5 | 2 | 4 | 5 |
| 45560 | 830730 | 10 | 13 | 3 | 4 | 4 | 4 | 4 | 4 | 99 | 4 | 5 | 6 | 7 | 8 | 9 | 9 | 10 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 2 | 5 | 6 |
| 45560 | 830731 | 10 | 11 | 3 | 6 | 5 | 7 | 6 | 6 | 99 | 5 | 6 | 7 | 8 | 9 | 10 | 10 | 10 | 9 | 8 | 8 | 7 | 6 | 5 | 1 | 3 | 4 | 4 |
| 45560 | 840706 | 10 | 14 | 1 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 4 | 6 | 7 | 8 | 8 | 10 | 9 | 8 | 7 | 6 | 4 | 4 | 3 | 4 | 3 |
| 45560 | 840716 | 10 | 10 | 2 | 4 | 4 | 4 | 4 | 3 | 3 | 2 | 3 | 5 | 6 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 8 | 7 | 7 | 4 | 4 | 4 | 4 |

## Ozone Exceedence Days

## 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
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| 45558 | 870626 | 10 | 11 | 5 | 3 | 2 | 2 | 99 | 2 | 2 | 2 | 2 | 5 | 7 | 8 | 10 | 10 | 10 | 10 | 9 | 9 | 10 | 9 | 9 | 8 | 6 | 4 | 4 |
| 45558 | 870627 | 10 | 14 | 1 | 4 | 3 | 2 | 99 | 2 | 2 | 4 | 3 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 8 | 8 | 8 | 8 | 7 | 3 | 5 | 8 | 7 |
| 45558 | 870714 | 11 | 11 | 1 | 3 | 2 | 2 | 99 | 2 | 2 | 1 | 2 | 5 | 7 | 9 | 11 | 8 | 8 | 7 | 7 | 10 | 9 | 7 | 6 | 8 | 6 | 6 | 5 |
| 45558 | 870715 | 10 | 15 | 2 | 4 | 2 | 3 | 99 | 0 | 0 | 1 | 3 | 3 | 5 | 7 | 7 | 8 | 9 | 8 | 10 | 10 | 8 | 8 | 8 | 7 | 7 | 6 | 3 |
| 45558 | 870808 | 10 | 15 | 2 | 6 | 3 | 1 | 99 | 2 | 2 | 1 | 2 | 4 | 5 | 7 | 9 | 9 | 9 | 9 | 10 | 10 | 8 | 7 | 5 | 4 | 4 | 4 | 3 |
| 45558 | 870831 | 10 | 12 | 1 | 1 | 2 | 2 | 99 | 1 | 0 | 0 | 0 | 1 | 4 | 8 | 9 | 10 | 8 | 8 | 8 | 7 | 7 | 9 | 8 | 4 | 3 | 5 | 5 |
| 45558 | 870902 | 10 | 16 | 1 | 3 | 2 | 2 | 99 | 2 | 1 | 1 | 1 | 1 | 3 | 6 | 7 | 4 | 99 | 99 | 9 | 10 | 8 | 7 | 6 | 6 | 2 | 3 | 4 |
| 45558 | 870903 | 10 | 12 | 1 | 3 | 2 | 2 | 99 | 1 | 1 | 1 | 1 | 2 | 4 | 6 | 9 | 10 | 8 | 7 | 5 | 2 | 1 | 2 | 2 | 1 | 1 | 3 | 2 |
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| 45558 | 870919 | 10 | 14 | 1 | 2 | 1 | 1 | 99 | 2 | 1 | 1 | 1 | 3 | 5 | 6 | 6 | 9 | 9 | 10 | 8 | 9 | 8 | 4 | 0 | 2 | 3 | 3 | 2 |
| 45558 | 870923 | 11 | 15 | 1 | 3 | 2 | 2 | 99 | 1 | 2 | 0 | 1 | 1 | 2 | 5 | 9 | 10 | 10 | 10 | 11 | 9 | 9 | 6 | 3 | 5 | 5 | 3 | 3 |
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| 45558 | 871016 | 10 | 15 | 2 | 1 | 1 | 1 | 99 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 7 | 8 | 9 | 10 | 10 | 5 | 2 | 5 | 4 | 3 | 3 | 2 |

# Ozone Exceedence Days

# 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
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| 45564 | 850618 | 12 | 11 | 2 | 4 | 4 | 3 | 3 | 2 | 1 | 2 | 4 | 6 | 8 | 10 | 12 | 11 | 8 | 10 | 12 | 10 | 11 | 9 | 7 | 6 | 4 | 4 | 5 |
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| 45564 | 850717 | 10 | 11 | 1 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 5 | 6 | 9 | 10 | 9 | 9 | 9 | 9 | 9 | 9 | 7 | 6 | 1 | 2 | 2 | 3 |
| 45564 | 850718 | 11 | 11 | 1 | 4 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 5 | 7 | 10 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 7 | 4 | 3 | 1 | 1 | 3 |
| 45564 | 850719 | 10 | 11 | 1 | 4 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 5 | 6 | 9 | 10 | 9 | 8 | 8 | 9 | 9 | 8 | 6 | 5 | 5 | 3 | 1 | 3 |
| 45564 | 850726 | 11 | 14 | 2 | 5 | 5 | 4 | 4 | 3 | 1 | 2 | 3 | 5 | 7 | 8 | 9 | 9 | 10 | 11 | 11 | 9 | 7 | 6 | 5 | 4 | 4 | 4 | 4 |
| 45564 | 850814 | 10 | 12 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 4 | 5 | 8 | 9 | 10 | 10 | 9 | 9 | 8 | 8 | 8 | 7 | 6 | 4 | 4 | 3 |
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| 45564 | 860802 | 10 | 12 | 2 | 2 | 2 | 2 | 99 | 3 | 2 | 2 | 4 | 5 | 6 | 8 | 9 | 10 | 10 | 9 | 8 | 7 | 6 | 5 | 3 | 1 | 1 | 2 | 2 |
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| 45564 | 870626 | 13 | 13 | 1 | 3 | 3 | 3 | 99 | 2 | 2 | 2 | 3 | 5 | 7 | 9 | 10 | 11 | 13 | 12 | 10 | 11 | 10 | 10 | 9 | 8 | 6 | 4 | 4 |
| 45564 | 870713 | 10 | 10 | 5 | 3 | 4 | 3 | 99 | 2 | 2 | 1 | 3 | 6 | 8 | 10 | 10 | 10 | 10 | 9 | 8 | 10 | 9 | 8 | 7 | 6 | 5 | 2 | 3 |
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| 45564 | 870715 | 10 | 12 | 3 | 4 | 3 | 4 | 99 | 1 | 1 | 1 | 3 | 4 | 6 | 8 | 9 | 10 | 10 | 9 | 9 | 9 | 10 | 8 | 7 | 6 | 5 | 5 | 5 |
| 45564 | 870804 | 11 | 11 | 1 | 4 | 3 | 2 | 99 | 1 | 1 | 1 | 3 | 6 | 8 | 10 | 11 | 8 | 10 | 10 | 10 | 10 | 8 | 7 | 2 | 1 | 1 | 2 | 2 |
| 45564 | 870808 | 11 | 13 | 1 | 2 | 2 | 3 | 99 | 1 | 1 | 2 | 4 | 6 | 8 | 9 | 9 | 8 | 11 | 10 | 10 | 10 | 8 | 8 | 5 | 2 | 1 | 1 | 4 |
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| 45564 | 870818 | 10 | 11 | 6 | 4 | 4 | 4 | 99 | 2 | 1 | 1 | 1 | 4 | 7 | 9 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 8 | 8 | 8 | 7 | 6 |
| 45564 | 870821 | 10 | 14 | 1 | 4 | 4 | 3 | 99 | 4 | 1 | 1 | 2 | 4 | 6 | 8 | 9 | 9 | 9 | 10 | 9 | 9 | 8 | 7 | 7 | 3 | 0 | 0 | 1 |
| 45564 | 870827 | 10 | 11 | 4 | 3 | 4 | 4 | 99 | 0 | 0 | 1 | 3 | 3 | 5 | 6 | 10 | 10 | 9 | 10 | 10 | 8 | 8 | 7 | 2 | 0 | 0 | 1 | 2 |
| 45564 | 870901 | 13 | 14 | 1 | 5 | 5 | 4 | 99 | 3 | 2 | 1 | 1 | 3 | 5 | 7 | 8 | 10 | 10 | 13 | 10 | 9 | 8 | 8 | 4 | 2 | 4 | 5 | 5 |
| 45564 | 870902 | 10 | 12 | 3 | 5 | 5 | 4 | 99 | 3 | 2 | 1 | 1 | 2 | 4 | 6 | 8 | 10 | 10 | 10 | 9 | 8 | 7 | 1 | 1 | 1 | 1 | 1 | 1 |
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| 45564 | 880727 | 10 | 14 | 1 | 2 | 2 | 2 | 1 | 99 | 1 | 1 | 1 | 3 | 5 | 6 | 7 | 7 | 99 | 10 | 9 | 8 | 7 | 6 | 5 | 3 | 1 | 1 | 3 |
| 45564 | 880810 | 10 | 11 | 1 | 3 | 3 | 2 | 2 | 99 | 0 | 1 | 2 | 3 | 5 | 7 | 10 | 9 | 9 | 9 | 8 | 8 | 7 | 6 | 8 | 6 | 2 | 2 | 2 |
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# Ozone Exceedence Days

# 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
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| 51895 | 820422 | 10 | 14 | 1 | 99 | 3 | 2 | 1 | 1 | 0 | 1 | 1 | 2 | 4 | 5 | 7 | 8 | 9 | 10 | 9 | 8 | 8 | 7 | 6 | 6 | 4 | 4 | 4 |
| 51895 | 820521 | 10 | 14 | 2 | 99 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 4 | 6 | 8 | 9 | 9 | 10 | 10 | 9 | 9 | 8 | 7 | 5 | 3 | 2 | 2 |
| 51895 | 820617 | 10 | 13 | 1 | 99 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 5 | 6 | 8 | 10 | 9 | 9 | 8 | 6 | 4 | 4 | 3 | 2 | 2 | 2 |
| 51895 | 820823 | 10 | 15 | 1 | 99 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 4 | 6 | 6 | 7 | 9 | 10 | 9 | 7 | 6 | 4 | 3 | 2 | 1 | 1 |
| 51895 | 820824 | 10 | 13 | 2 | 99 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 4 | 5 | 8 | 10 | 10 | 9 | 8 | 8 | 6 | 4 | 2 | 1 | 0 | 1 |
| 51895 | 820908 | 11 | 15 | 1 | 99 | 5 | 4 | 4 | 3 | 1 | 1 | 2 | 5 | 6 | 7 | 7 | 9 | 10 | 10 | 11 | 10 | 10 | 10 | 7 | 6 | 4 | 4 | 4 |
| 51895 | 830526 | 10 | 12 | 5 | 99 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 7 | 8 | 8 | 10 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 5 | 4 | 3 | 4 |
| 51895 | 830527 | 10 | 13 | 1 | 99 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 5 | 7 | 8 | 9 | 10 | 9 | 9 | 9 | 9 | 7 | 6 | 5 | 4 | 2 | 2 |
| 51895 | 830730 | 10 | 17 | 1 | 99 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 9 | 9 | 9 | 9 | 10 | 8 | 5 | 4 | 2 | 2 | 2 |
| 51895 | 830807 | 10 | 16 | 1 | 99 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 5 | 5 | 7 | 8 | 8 | 8 | 9 | 9 | 10 | 9 | 8 | 7 | 4 | 4 | 4 | 5 |
| 51895 | 830811 | 10 | 12 | 1 | 99 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 5 | 7 | 10 | 8 | 7 | 8 | 7 | 6 | 5 | 4 | 3 | 1 | 0 | 0 |
| 51895 | 830813 | 10 | 17 | 1 | 99 | 2 | 2 | 1 | 1 | 0 | 1 | 2 | 4 | 5 | 5 | 6 | 6 | 7 | 7 | 8 | 9 | 10 | 9 | 5 | 4 | 3 | 3 | 3 |
| 51895 | 830814 | 10 | 15 | 1 | 99 | 2 | 2 | 1 | 1 | 0 | 1 | 2 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 10 | 9 | 8 | 6 | 6 | 4 | 3 | 3 | 2 |
| 51895 | 830921 | 10 | 16 | 1 | 99 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 99 | 99 | 4 | 7 | 9 | 9 | 10 | 8 | 2 | 1 | 1 | 1 | 0 | 1 |
| 51895 | 840625 | 10 | 11 | 5 | 99 | 4 | 3 | 2 | 2 | 2 | 2 | 3 | 5 | 7 | 9 | 10 | 10 | 10 | 9 | 8 | 10 | 10 | 9 | 7 | 5 | 4 | 3 | 2 |
| 51895 | 840625 | 10 | 11 | 5 | 99 | 4 | 3 | 2 | 2 | 2 | 2 | 3 | 5 | 7 | 9 | 10 | 10 | 10 | 9 | 8 | 10 | 10 | 9 | 7 | 5 | 4 | 3 | 2 |
| 51895 | 840703 | 10 | 13 | 5 | 99 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 5 | 7 | 99 | 9 | 10 | 10 | 10 | 10 | 10 | 8 | 6 | 5 | 3 | 3 | 2 |
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| 51895 | 840715 | 10 | 16 | 1 | 99 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 6 | 6 | 7 | 8 | 7 | 7 | 10 | 9 | 7 | 6 | 6 | 5 | 5 | 5 |
| 51895 | 840716 | 11 | 16 | 1 | 99 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 4 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 10 | 9 | 8 | 6 | 4 | 3 | 2 |
| 51895 | 840717 | 12 | 15 | 1 | 2 | 2 | 2 | 2 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 8 | 10 | 12 | 10 | 9 | 9 | 6 | 4 | 4 | 4 | 3 |
| 51895 | 840718 | 10 | 12 | 5 | 3 | 3 | 3 | 3 | 99 | 2 | 3 | 4 | 4 | 5 | 7 | 8 | 10 | 10 | 10 | 10 | 10 | 8 | 6 | 5 | 4 | 3 | 2 | 3 |
| 51895 | 840809 | 11 | 12 | 1 | 3 | 2 | 3 | 3 | 99 | 0 | 1 | 2 | 4 | 7 | 9 | 9 | 11 | 8 | 9 | 9 | 8 | 8 | 7 | 6 | 4 | 3 | 2 | 1 |
| 51895 | 840810 | 10 | 17 | 1 | 1 | 2 | 2 | 2 | 99 | 2 | 1 | 2 | 2 | 2 | 2 | 4 | 5 | 6 | 6 | 6 | 8 | 10 | 8 | 5 | 4 | 4 | 3 | 2 |
| 51895 | 841002 | 11 | 17 | 1 | 1 | 1 | 0 | 0 | 99 | 0 | 0 | 0 | 2 | 3 | 4 | 5 | 6 | 6 | 8 | 9 | 10 | 11 | 7 | 6 | 4 | 3 | 2 | 2 |
| 51895 | 850620 | 10 | 16 | 2 | 99 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 5 | 7 | 8 | 7 | 9 | 10 | 10 | 9 | 8 | 7 | 4 | 2 | 2 |
| 51895 | 850621 | 10 | 12 | 4 | 99 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 5 | 7 | 9 | 10 | 10 | 10 | 10 | 9 | 9 | 8 | 5 | 4 | 3 | 3 | 2 |
| 51895 | 850627 | 10 | 12 | 3 | 99 | 5 | 5 | 4 | 2 | 1 | 2 | 4 | 5 | 7 | 8 | 9 | 10 | 10 | 10 | 9 | 9 | 9 | 7 | 6 | 5 | 4 | 3 | 3 |
| 51895 | 850712 | 10 | 13 | 2 | 99 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 5 | 6 | 8 | 9 | 10 | 10 | 9 | 9 | 9 | 9 | 5 | 5 | 5 | 3 | 2 |
| 51895 | 850714 | 10 | 12 | 2 | 99 | 4 | 3 | 2 | 2 | 1 | 2 | 4 | 5 | 6 | 8 | 9 | 10 | 10 | 9 | 8 | 8 | 8 | 7 | 5 | 4 | 4 | 4 | 3 |
| 51895 | 850715 | 10 | 12 | 2 | 99 | 2 | 1 | 99 | 99 | 1 | 2 | 3 | 3 | 5 | 7 | 9 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 6 | 6 | 4 | 4 | 4 |
| 51895 | 850724 | 10 | 11 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 2 | 4 | 6 | 8 | 10 | 10 | 9 | 8 | 7 | 7 | 7 | 6 | 6 | 6 | 5 | 3 | 99 |
| 51895 | 850726 | 10 | 13 | 5 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 4 | 6 | 8 | 10 | 10 | 10 | 10 | 10 | 9 | 6 | 3 | 2 | 2 | 99 |
| 51895 | 850823 | 10 | 16 | 1 | 99 | 2 | 1 | 0 | 0 | 0 | 0 | 99 | 3 | 4 | 6 | 7 | 8 | 8 | 8 | 9 | 10 | 8 | 6 | 5 | 3 | 2 | 4 | 4 |
| 51895 | 851005 | 11 | 14 | 3 | 99 | 1 | 4 | 4 | 4 | 1 | 1 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 11 | 11 | 10 | 8 | 6 | 3 | 5 | 5 | 5 |
| 51895 | 851011 | 10 | 14 | 1 | 99 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 4 | 5 | 5 | 7 | 10 | 7 | 8 | 5 | 3 | 3 | 2 | 0 | 1 | 1 |
| 51895 | 851018 | 11 | 16 | 1 | 5 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 4 | 7 | 8 | 8 | 10 | 11 | 7 | 4 | 4 | 2 | 1 | 2 | 2 |
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| 51895 | 860721 | 14 | 14 | 1 | 4 | 99 | 2 | 2 | 1 | 0 | 1 | 3 | 6 | 7 | 7 | 10 | 9 | 11 | 14 | 10 | 11 | 10 | 7 | 6 | 5 | 5 | 5 | 4 |
| 51895 | 860801 | 10 | 14 | 2 | 1 | 99 | 1 | 0 | 0 | 0 | 0 | 99 | 99 | 7 | 8 | 9 | 9 | 9 | 10 | 10 | 9 | 9 | 7 | 4 | 2 | 2 | 1 | 2 |
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# Ozone Exceedence Days

# 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
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| 51895 | 860814 | 10 | 14 | 1 | 2 | 99 | 1 | 1 | 0 | 0 | 1 | 2 | 2 | 3 | 4 | 6 | 99 | 8 | 10 | 9 | 9 | 8 | 5 | 3 | 3 | 2 | 2 | 2 |
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| 51895 | 860820 | 11 | 14 | 1 | 4 | 99 | 3 | 2 | 1 | 0 | 1 | 2 | 4 | 6 | 7 | 10 | 10 | 9 | 11 | 10 | 10 | 8 | 6 | 5 | 4 | 3 | 2 | 2 |
| 51895 | 860821 | 10 | 16 | 1 | 2 | 99 | 2 | 2 | 2 | 2 | 2 | 2 | 99 | 3 | 4 | 6 | 7 | 8 | 8 | 8 | 10 | 9 | 8 | 7 | 5 | 3 | 2 | 2 |
| 51895 | 860826 | 10 | 12 | 2 | 3 | 99 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 3 | 5 | 8 | 10 | 10 | 8 | 8 | 8 | 8 | 6 | 3 | 3 | 2 | 3 | 3 |
| 51895 | 860827 | 10 | 13 | 2 | 3 | 99 | 1 | 0 | 0 | 0 | 1 | 1 | 3 | 4 | 5 | 6 | 8 | 10 | 10 | 7 | 5 | 4 | 3 | 2 | 2 | 1 | 1 | 1 |
| 51895 | 860830 | 10 | 14 | 1 | 1 | 99 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 8 | 7 | 8 | 6 | 5 | 4 | 2 | 2 | 3 |
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| 51895 | 861010 | 12 | 15 | 1 | 1 | 99 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 4 | 5 | 7 | 9 | 9 | 12 | 8 | 5 | 3 | 2 | 1 | 1 | 1 | 1 |
| 51895 | 861020 | 11 | 15 | 1 | 2 | 99 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 11 | 10 | 7 | 5 | 4 | 1 | 2 | 2 | 2 |
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| 51895 | 870422 | 11 | 17 | 1 | 5 | 99 | 3 | 1 | 1 | 0 | 0 | 2 | 4 | 5 | 6 | 8 | 8 | 9 | 10 | 10 | 10 | 11 | 10 | 7 | 6 | 5 | 5 | 6 |
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| 51895 | 870803 | 10 | 14 | 1 | 3 | 99 | 3 | 2 | 1 | 0 | 1 | 3 | 4 | 99 | 6 | 7 | 7 | 8 | 10 | 8 | 9 | 9 | 9 | 7 | 5 | 3 | 3 | 4 |
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| 51895 | 870829 | 10 | 15 | 1 | 1 | 99 | 1 | 1 | 0 | 0 | 0 | 2 | 3 | 5 | 7 | 7 | 7 | 7 | 9 | 10 | 9 | 8 | 7 | 5 | 2 | 3 | 3 | 3 |
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| 51895 | 871016 | 10 | 13 | 4 | 4 | 3 | 4 | 3 | 3 | 1 | 0 | 0 | 99 | 3 | 5 | 7 | 9 | 10 | 10 | 10 | 10 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 51895 | 880520 | 11 | 17 | 1 | 3 | 3 | 2 | 1 | 99 | 1 | 1 | 3 | 4 | 5 | 7 | 8 | 10 | 9 | 9 | 10 | 10 | 11 | 8 | 5 | 3 | 1 | 1 | 2 |
| 51895 | 880521 | 11 | 14 | 3 | 3 | 4 | 3 | 2 | 99 | 1 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 10 | 11 | 11 | 11 | 10 | 8 | 7 | 6 | 5 | 5 | 4 |
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| 51895 | 880726 | 12 | 14 | 1 | 2 | 1 | 1 | 1 | 99 | 0 | 1 | 2 | 3 | 4 | 6 | 7 | 9 | 9 | 12 | 11 | 8 | 5 | 5 | 4 | 4 | 3 | 3 | 2 |
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| 51895 | 880729 | 10 | 17 | 1 | 4 | 2 | 1 | 0 | 99 | 0 | 1 | 2 | 3 | 5 | 7 | 8 | 9 | 9 | 8 | 7 | 9 | 10 | 9 | 8 | 6 | 3 | 3 | 3 |
| 51895 | 880730 | 11 | 16 | 1 | 5 | 4 | 2 | 1 | 99 | 0 | 1 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 10 | 11 | 10 | 8 | 5 | 3 | 2 | 2 | 2 |
| 51895 | 880826 | 11 | 14 | 3 | 2 | 1 | 2 | 1 | 99 | 0 | 1 | 1 | 4 | 6 | 8 | 9 | 10 | 10 | 11 | 11 | 11 | 9 | 6 | 5 | 4 | 2 | 1 | 1 |

## Ozone Exceedence Days

## 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51895 | 880827 | 10 | 17 | 1 | 1 | 1 | 0 | 0 | 99 | 0 | 0 | 2 | 2 | 5 | 7 | 9 | 9 | 9 | 9 | 9 | 9 | 10 | 7 | 4 | 3 | 3 | 4 | 3 |
| 51895 | 880830 | 11 | 17 | 1 | 4 | 3 | 3 | 2 | 99 | 0 | 0 | 1 | 6 | 6 | 8 | 10 | 10 | 10 | 10 | 10 | 9 | 11 | 9 | 6 | 4 | 3 | 3 | 2 |
| 51895 | 880831 | 11 | 16 | 1 | 1 | 1 | 1 | 1 | 99 | 1 | 1 | 2 | 2 | 3 | 4 | 6 | 8 | 8 | 9 | 10 | 11 | 9 | 8 | 6 | 4 | 3 | 2 | 2 |
| 51895 | 880902 | 11 | 14 | 1 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 3 | 4 | 5 | 6 | 9 | 10 | 11 | 10 | 9 | 8 | 7 | 6 | 3 | 2 | 2 | 1 |
| 51895 | 880903 | 11 | 12 | 5 | 0 | 0 | 0 | 0 | 99 | 0 | 0 | 1 | 2 | 5 | 7 | 9 | 11 | 11 | 11 | 11 | 11 | 10 | 9 | 7 | 5 | 4 | 3 | 3 |
| 51895 | 880904 | 10 | 14 | 3 | 1 | 1 | 0 | 1 | 99 | 1 | 1 | 2 | 5 | 6 | 8 | 9 | 9 | 9 | 10 | 10 | 10 | 9 | 7 | 5 | 4 | 5 | 5 | 4 |
| 51895 | 880905 | 11 | 13 | 2 | 1 | 0 | 2 | 3 | 99 | 1 | 1 | 3 | 5 | 8 | 8 | 9 | 10 | 11 | 11 | 10 | 10 | 7 | 5 | 3 | 3 | 2 | 3 | 3 |
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| 51895 | 880915 | 10 | 13 | 4 | 2 | 2 | 2 | 2 | 99 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 10 | 10 | 10 | 9 | 8 | 5 | 3 | 2 | 2 | 2 |
| 51895 | 880922 | 10 | 17 | 1 | 3 | 3 | 2 | 2 | 99 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 8 | 9 | 9 | 10 | 7 | 5 | 5 | 4 | 4 | 5 |
| 51895 | 880924 | 10 | 12 | 1 | 3 | 4 | 3 | 3 | 99 | 1 | 1 | 2 | 4 | 5 | 7 | 9 | 10 | 9 | 8 | 8 | 8 | 6 | 5 | 5 | 4 | 4 | 4 | 4 |
| 51895 | 880930 | 10 | 12 | 3 | 3 | 3 | 1 | 1 | 99 | 1 | 1 | 1 | 3 | 5 | 7 | 9 | 10 | 10 | 10 | 9 | 9 | 8 | 5 | 3 | 1 | 2 | 2 | 1 |
| 51895 | 881001 | 12 | 14 | 1 | 3 | 3 | 3 | 3 | 99 | 1 | 1 | 2 | 4 | 6 | 8 | 9 | 9 | 10 | 12 | 11 | 11 | 7 | 5 | 4 | 3 | 2 | 2 | 2 |
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| 51895 | 881022 | 10 | 14 | 2 | 0 | 0 | 0 | 0 | 99 | 0 | 0 | 0 | 2 | 3 | 5 | 6 | 8 | 9 | 10 | 10 | 9 | 7 | 6 | 5 | 2 | 5 | 5 | 5 |
| 51895 | 881025 | 10 | 14 | 2 | 4 | 2 | 1 | 1 | 99 | 1 | 1 | 1 | 2 | 3 | 4 | 6 | 8 | 9 | 10 | 10 | 9 | 7 | 5 | 5 | 3 | 2 | 1 | 2 |
| 51895 | 890706 | 10 | 13 | 1 | 2 | 2 | 1 | 1 | 99 | 1 | 1 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 9 | 9 | 9 | 9 | 7 | 2 | 1 | 1 | 0 | 1 |
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| 51895 | 890828 | 10 | 12 | 1 | 3 | 2 | 2 | 1 | 99 | 0 | 0 | 3 | 3 | 5 | 7 | 8 | 10 | 9 | 9 | 9 | 9 | 8 | 6 | 5 | 4 | 3 | 3 | 3 |

# Ozone Exceedence Days

# 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51897 | 820820 | 10 | 17 | 1 | 0 | 0 | 0 | 0 | 99 | 1 | 1 | 1 | 2 | 3 | 5 | 7 | 99 | 99 | 9 | 9 | 9 | 10 | 6 | 3 | 2 | 1 | 1 | 1 |
| 51897 | 820907 | 13 | 17 | 1 | 1 | 1 | 1 | 1 | 99 | 1 | 1 | 2 | 4 | 4 | 6 | 5 | 6 | 99 | 9 | 8 | 12 | 13 | 12 | 9 | 5 | 7 | 5 | 1 |
| 51897 | 820908 | 14 | 15 | 1 | 1 | 3 | 3 | 2 | 99 | 2 | 1 | 1 | 2 | 4 | 7 | 9 | 10 | 12 | 13 | 14 | 11 | 7 | 5 | 3 | 3 | 2 | 3 | 3 |
| 51897 | 821012 | 10 | 14 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 5 | 6 | 8 | 8 | 8 | 10 | 10 | 10 | 8 | 8 | 7 | 5 | 4 | 99 | 2 |
| 51897 | 821014 | 11 | 14 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 99 | 3 | 4 | 6 | 9 | 10 | 11 | 10 | 9 | 6 | 7 | 4 | 1 | 0 | 99 | 2 |
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| 51897 | 830807 | 10 | 13 | 4 | 99 | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 4 | 4 | 5 | 7 | 9 | 10 | 10 | 10 | 10 | 7 | 7 | 5 | 3 | 2 | 1 | 2 |
| 51897 | 830808 | 10 | 13 | 1 | 99 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 5 | 6 | 8 | 10 | 9 | 8 | 9 | 8 | 3 | 1 | 1 | 1 | 1 | 0 |
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| 51897 | 840614 | 10 | 16 | 1 | 99 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 5 | 6 | 7 | 8 | 7 | 8 | 10 | 7 | 5 | 3 | 2 | 2 | 1 | 1 |
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| 51897 | 840703 | 12 | 14 | 2 | 99 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 5 | 6 | 9 | 11 | 11 | 12 | 12 | 11 | 9 | 6 | 3 | 2 | 1 | 1 | 1 |
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| 51897 | 840712 | 10 | 12 | 1 | 99 | 2 | 2 | 1 | 1 | 1 | 2 | 4 | 6 | 7 | 9 | 9 | 10 | 9 | 8 | 8 | 8 | 8 | 8 | 7 | 2 | 1 | 1 | 1 |
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| 51897 | 840914 | 11 | 14 | 1 | 99 | 0 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 5 | 8 | 9 | 9 | 10 | 11 | 10 | 9 | 7 | 5 | 3 | 1 | 1 | 1 | 1 |
| 51897 | 840917 | 10 | 17 | 1 | 99 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 3 | 4 | 5 | 6 | 6 | 8 | 9 | 8 | 9 | 10 | 7 | 5 | 2 | 1 | 1 | 0 |
| 51897 | 840918 | 10 | 13 | 3 | 99 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 5 | 7 | 8 | 9 | 10 | 10 | 10 | 9 | 7 | 6 | 3 | 4 | 2 | 1 | 1 |
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| 51897 | 850618 | 12 | 13 | 2 | 99 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 6 | 8 | 10 | 12 | 12 | 11 | 10 | 7 | 5 | 4 | 3 | 2 | 2 | 2 |
| 51897 | 850620 | 10 | 16 | 1 | 99 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 4 | 4 | 5 | 7 | 8 | 9 | 10 | 9 | 6 | 4 | 2 | 2 | 1 | 1 |
| 51897 | 850627 | 10 | 14 | 2 | 99 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 6 | 8 | 8 | 9 | 8 | 10 | 10 | 9 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 51897 | 850712 | 10 | 13 | 2 | 99 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 5 | 7 | 9 | 10 | 9 | 10 | 9 | 9 | 7 | 5 | 3 | 1 | 1 | 1 |
| 51897 | 850715 | 10 | 12 | 3 | 99 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 4 | 5 | 99 | 10 | 10 | 10 | 9 | 7 | 8 | 7 | 5 | 4 | 3 | 3 | 2 |
| 51897 | 850724 | 10 | 12 | 1 | 99 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 5 | 7 | 8 | 10 | 8 | 7 | 7 | 8 | 9 | 7 | 5 | 3 | 2 | 2 | 2 |
| 51897 | 850726 | 12 | 15 | 1 | 99 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 6 | 8 | 10 | 11 | 12 | 9 | 6 | 4 | 3 | 2 | 1 | 1 | 1 |
| 51897 | 850824 | 10 | 15 | 1 | 99 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 3 | 6 | 6 | 7 | 8 | 8 | 9 | 10 | 8 | 5 | 4 | 3 | 2 | 2 | 2 | 2 |
| 51897 | 851003 | 10 | 11 | 2 | 99 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 4 | 7 | 9 | 10 | 10 | 9 | 6 | 7 | 7 | 7 | 6 | 3 | 1 | 1 | 1 | 4 |
| 51897 | 851004 | 10 | 11 | 1 | 99 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 5 | 9 | 10 | 9 | 7 | 6 | 6 | 6 | 6 | 5 | 3 | 1 | 1 | 1 | 1 |
| 51897 | 851005 | 10 | 13 | 4 | 99 | 3 | 4 | 4 | 5 | 5 | 4 | 4 | 5 | 6 | 7 | 7 | 8 | 10 | 10 | 10 | 10 | 9 | 7 | 4 | 3 | 2 | 2 | 3 |
| 51897 | 860623 | 11 | 13 | 2 | 0 | 99 | 1 | 2 | 2 | 2 | 2 | 3 | 4 | 7 | 9 | 10 | 10 | 11 | 11 | 10 | 9 | 8 | 6 | 3 | 2 | 1 | 1 | 1 |
| 51897 | 860731 | 12 | 14 | 1 | 1 | 99 | 2 | 2 | 2 | 3 | 2 | 3 | 99 | 99 | 5 | 6 | 7 | 10 | 12 | 10 | 7 | 7 | 7 | 3 | 1 | 1 | 1 | 2 |
| 51897 | 860804 | 14 | 14 | 1 | 1 | 99 | 1 | 1 | 0 | 0 | 1 | 2 | 4 | 6 | 8 | 9 | 10 | 10 | 14 | 13 | 10 | 9 | 8 | 4 | 2 | 1 | 1 | 1 |
| 51897 | 860812 | 11 | 13 | 2 | 1 | 99 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 6 | 8 | 10 | 11 | 11 | 10 | 8 | 7 | 4 | 3 | 1 | 0 | 1 | 1 |

## Ozone Exceedence Days

## 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51897 | 860905 | 10 | 13 | 2 | 0 | 99 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 4 | 6 | 8 | 10 | 10 | 9 | 8 | 6 | 4 | 2 | 1 | 0 | 0 | 0 |
| 51897 | 870422 | 10 | 14 | 1 | 4 | 99 | 1 | 2 | 1 | 1 | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 9 | 10 | 9 | 9 | 9 | 6 | 5 | 4 | 4 | 2 | 3 |
| 51897 | 870507 | 11 | 15 | 1 | 2 | 99 | 1 | 0 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 6 | 7 | 9 | 11 | 9 | 5 | 5 | 4 | 4 | 3 | 3 | 3 |
| 51897 | 870603 | 10 | 13 | 1 | 2 | 99 | 4 | 4 | 4 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 9 | 10 | 9 | 9 | 8 | 7 | 5 | 4 | 3 | 2 | 3 | 2 |
| 51897 | 870625 | 11 | 16 | 1 | 1 | 99 | 2 | 3 | 2 | 2 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 9 | 9 | 10 | 11 | 9 | 8 | 5 | 4 | 3 | 3 | 3 |
| 51897 | 870626 | 10 | 14 | 1 | 3 | 99 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 8 | 7 | 6 | 5 | 4 | 3 | 3 | 3 | 3 |
| 51897 | 870714 | 10 | 13 | 1 | 1 | 99 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 6 | 8 | 9 | 10 | 9 | 8 | 6 | 5 | 5 | 3 | 3 | 2 | 1 | 1 |
| 51897 | 870801 | 10 | 17 | 2 | 0 | 99 | 1 | 2 | 1 | 2 | 2 | 3 | 4 | 7 | 7 | 8 | 7 | 8 | 9 | 9 | 9 | 10 | 10 | 8 | 7 | 3 | 1 | 1 |
| 51897 | 870803 | 10 | 14 | 2 | 2 | 99 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 5 | 6 | 8 | 9 | 10 | 10 | 9 | 8 | 6 | 5 | 4 | 3 | 2 | 2 |
| 51897 | 870902 | 14 | 13 | 1 | 0 | 99 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 4 | 8 | 11 | 14 | 12 | 10 | 8 | 7 | 5 | 3 | 3 | 2 | 3 | 3 |
| 51897 | 870918 | 10 | 14 | 2 | 1 | 99 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 10 | 9 | 8 | 3 | 2 | 1 | 1 | 0 | 1 |
| 51897 | 871010 | 10 | 15 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 99 | 1 | 2 | 2 | 3 | 3 | 4 | 7 | 8 | 10 | 8 | 8 | 6 | 5 | 5 | 3 | 2 | 1 |
| 51897 | 880520 | 11 | 14 | 3 | 0 | 0 | 1 | 1 | 99 | 1 | 1 | 3 | 4 | 5 | 6 | 7 | 9 | 10 | 11 | 11 | 11 | 10 | 9 | 7 | 6 | 4 | 3 | 3 |
| 51897 | 880521 | 13 | 14 | 1 | 2 | 3 | 3 | 2 | 99 | 2 | 2 | 4 | 6 | 7 | 8 | 9 | 10 | 12 | 13 | 11 | 11 | 8 | 7 | 5 | 5 | 5 | 4 | 3 |
| 51897 | 880622 | 11 | 13 | 1 | 2 | 2 | 2 | 2 | 99 | 1 | 2 | 2 | 2 | 3 | 4 | 6 | 9 | 11 | 10 | 10 | 10 | 10 | 10 | 7 | 3 | 2 | 1 | 1 |
| 51897 | 880708 | 10 | 12 | 4 | 2 | 1 | 1 | 1 | 99 | 1 | 2 | 3 | 4 | 6 | 8 | 9 | 10 | 10 | 10 | 10 | 6 | 4 | 3 | 2 | 1 | 1 | 1 | 1 |
| 51897 | 880721 | 10 | 15 | 1 | 4 | 5 | 4 | 4 | 99 | 2 | 2 | 1 | 2 | 2 | 4 | 5 | 6 | 8 | 9 | 10 | 9 | 7 | 6 | 5 | 5 | 4 | 4 | 4 |
| 51897 | 880722 | 11 | 14 | 1 | 5 | 4 | 5 | 5 | 99 | 3 | 3 | 2 | 3 | 3 | 4 | 7 | 99 | 99 | 11 | 10 | 9 | 8 | 6 | 5 | 5 | 4 | 4 | 3 |
| 51897 | 880723 | 10 | 15 | 2 | 4 | 3 | 3 | 3 | 99 | 2 | 2 | 2 | 2 | 3 | 4 | 6 | 8 | 8 | 9 | 10 | 10 | 6 | 5 | 5 | 3 | 3 | 3 | 2 |
| 51897 | 880726 | 10 | 15 | 1 | 1 | 2 | 1 | 1 | 99 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 9 | 10 | 9 | 7 | 6 | 3 | 2 | 1 | 1 | 1 |
| 51897 | 880728 | 10 | 14 | 2 | 1 | 1 | 1 | 1 | 99 | 1 | 1 | 2 | 2 | 3 | 3 | 5 | 7 | 8 | 10 | 10 | 9 | 7 | 6 | 3 | 2 | 1 | 1 | 1 |
| 51897 | 880729 | 11 | 15 | 1 | 1 | 1 | 1 | 1 | 99 | 1 | 1 | 1 | 2 | 3 | 5 | 8 | 10 | 10 | 10 | 11 | 10 | 9 | 6 | 3 | 3 | 3 | 2 | 1 |
| 51897 | 880730 | 10 | 13 | 2 | 1 | 1 | 1 | 1 | 99 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 10 | 9 | 8 | 6 | 4 | 3 | 2 | 1 | 1 | 2 |
| 51897 | 880827 | 11 | 13 | 3 | 1 | 1 | 1 | 1 | 99 | 1 | 1 | 2 | 3 | 3 | 4 | 6 | 8 | 11 | 11 | 11 | 8 | 5 | 4 | 4 | 3 | 3 | 3 | 3 |
| 51897 | 880829 | 15 | 16 | 1 | 2 | 2 | 2 | 2 | 99 | 1 | 1 | 1 | 2 | 3 | 4 | 7 | 7 | 8 | 8 | 10 | 15 | 11 | 6 | 5 | 4 | 3 | 3 | 2 |
| 51897 | 880830 | 11 | 14 | 2 | 2 | 2 | 2 | 2 | 99 | 1 | 1 | 1 | 1 | 2 | 4 | 6 | 8 | 9 | 11 | 11 | 8 | 7 | 5 | 3 | 2 | 2 | 2 | 1 |
| 51897 | 880831 | 10 | 15 | 1 | 1 | 1 | 2 | 2 | 99 | 1 | 1 | 1 | 1 | 2 | 2 | 4 | 6 | 8 | 8 | 10 | 7 | 4 | 4 | 3 | 2 | 2 | 1 | 1 |
| 51897 | 880901 | 10 | 14 | 2 | 1 | 1 | 1 | 1 | 99 | 0 | 1 | 2 | 99 | 99 | 99 | 5 | 7 | 9 | 10 | 10 | 8 | 5 | 4 | 4 | 2 | 2 | 2 | 1 |
| 51897 | 880903 | 12 | 14 | 1 | 0 | 0 | 0 | 0 | 99 | 0 | 1 | 1 | 8 | 4 | 4 | 7 | 9 | 11 | 12 | 11 | 10 | 7 | 4 | 4 | 3 | 2 | 1 | 1 |
| 51897 | 880904 | 10 | 13 | 3 | 1 | 1 | 0 | 0 | 99 | 1 | 1 | 1 | 2 | 4 | 6 | 8 | 8 | 10 | 10 | 10 | 9 | 8 | 6 | 4 | 3 | 2 | 2 | 2 |
| 51897 | 880905 | 12 | 14 | 1 | 1 | 1 | 0 | 0 | 99 | 1 | 1 | 1 | 2 | 3 | 6 | 8 | 9 | 11 | 12 | 11 | 9 | 8 | 7 | 5 | 2 | 1 | 1 | 1 |
| 51897 | 880907 | 10 | 16 | 1 | 1 | 1 | 1 | 1 | 99 | 1 | 1 | 1 | 1 | 2 | 4 | 6 | 7 | 7 | 8 | 7 | 10 | 9 | 8 | 6 | 1 | 1 | 1 | 1 |
| 51897 | 880908 | 10 | 14 | 1 | 1 | 2 | 2 | 1 | 99 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 6 | 8 | 10 | 8 | 6 | 3 | 2 | 1 | 1 | 1 | 1 | 1 |
| 51897 | 880914 | 10 | 14 | 3 | 0 | 0 | 0 | 0 | 99 | 0 | 0 | 1 | 2 | 4 | 6 | 9 | 9 | 9 | 10 | 10 | 10 | 9 | 4 | 2 | 2 | 1 | 1 | 1 |
| 51897 | 880915 | 10 | 14 | 1 | 1 | 2 | 2 | 2 | 99 | 2 | 1 | 2 | 2 | 3 | 4 | 6 | 7 | 9 | 10 | 9 | 8 | 5 | 3 | 2 | 2 | 2 | 1 | 1 |
| 51897 | 880930 | 11 | 14 | 3 | 1 | 2 | 2 | 1 | 99 | 99 | 1 | 1 | 2 | 3 | 5 | 7 | 8 | 10 | 11 | 11 | 11 | 10 | 9 | 8 | 5 | 6 | 2 | 1 |
| 51897 | 881001 | 10 | 13 | 1 | 0 | 0 | 1 | 2 | 99 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 7 | 10 | 8 | 7 | 6 | 4 | 2 | 2 | 1 | 1 | 1 | 1 |
| 51897 | 881009 | 10 | 13 | 4 | 4 | 3 | 3 | 2 | 99 | 1 | 1 | 2 | 4 | 4 | 7 | 8 | 9 | 10 | 10 | 10 | 10 | 9 | 8 | 2 | 2 | 1 | 1 | 2 |
| 51897 | 881010 | 11 | 19 | 1 | 2 | 2 | 2 | 2 | 99 | 1 | 1 | 1 | 2 | 2 | 3 | 4 | 5 | 99 | 5 | 8 | 8 | 8 | 8 | 11 | 6 | 4 | 4 | 5 |
| 51897 | 881021 | 11 | 12 | 1 | 2 | 3 | 2 | 2 | 99 | 2 | 1 | 2 | 3 | 4 | 4 | 5 | 11 | 8 | 7 | 6 | 5 | 3 | 1 | 0 | 0 | 0 | 0 | 0 |
| 51897 | 881023 | 10 | 17 | 1 | 0 | 0 | 1 | 1 | 99 | 1 | 1 | 1 | 2 | 2 | 3 | 5 | 7 | 8 | 9 | 9 | 9 | 10 | 7 | 2 | 0 | 0 | 1 | 1 |
| 51897 | 890904 | 10 | 16 | 1 | 1 | 1 | 1 | 2 | 99 | 2 | 2 | 3 | 4 | 6 | 6 | 7 | 8 | 8 | 9 | 8 | 10 | 9 | 5 | 2 | 2 | 2 | 2 | 1 |

# Ozone Exceedence Days

# 1980-89 ARB Data

| Site Code | Date | Max | Hour | Count | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 57574 | 820619 | 11 | 16 | 2 | 1 | 1 | 0 | 1 | 99 | 2 | 2 | 2 | 3 | 3 | 6 | 5 | 6 | 9 | 10 | 8 | 11 | 11 | 10 | 7 | 2 | 2 | 3 | 0 |
| 57574 | 820620 | 10 | 17 | 1 | 2 | 2 | 2 | 2 | 99 | 2 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 9 | 9 | 10 | 7 | 4 | 2 | 1 | 1 | 2 |
| 57574 | 820621 | 10 | 16 | 1 | 2 | 2 | 1 | 1 | 99 | 1 | 2 | 2 | 2 | 2 | 3 | 4 | 6 | 7 | 8 | 9 | 10 | 9 | 7 | 4 | 2 | 1 | 1 | 1 |
| 57574 | 820719 | 10 | 16 | 1 | 1 | 1 | 1 | 1 | 99 | 99 | 1 | 2 | 3 | 3 | 5 | 6 | 7 | 8 | 8 | 9 | 10 | 9 | 7 | 6 | 5 | 2 | 1 | 1 |
| 57574 | 820723 | 10 | 12 | 4 | 2 | 2 | 2 | 2 | 99 | 99 | 2 | 3 | 5 | 6 | 8 | 8 | 10 | 9 | 9 | 10 | 10 | 10 | 9 | 5 | 4 | 2 | 2 | 2 |
| 57574 | 820724 | 10 | 14 | 2 | 2 | 3 | 2 | 2 | 99 | 99 | 3 | 3 | 4 | 5 | 6 | 6 | 8 | 8 | 10 | 10 | 9 | 7 | 7 | 6 | 4 | 3 | 2 | 2 |
| 57574 | 820727 | 10 | 15 | 2 | 2 | 2 | 2 | 2 | 99 | 99 | 3 | 3 | 4 | 5 | 6 | 7 | 9 | 9 | 9 | 10 | 10 | 8 | 7 | 5 | 3 | 3 | 2 | 2 |
| 57574 | 820728 | 10 | 12 | 4 | 3 | 3 | 2 | 2 | 99 | 99 | 2 | 4 | 5 | 7 | 8 | 9 | 10 | 10 | 10 | 10 | 8 | 8 | 6 | 6 | 3 | 2 | 2 | 3 |
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| 57574 | 820822 | 10 | 13 | 3 | 1 | 1 | 99 | 1 | 1 | 1 | 1 | 3 | 5 | 7 | 8 | 9 | 9 | 10 | 10 | 10 | 9 | 8 | 6 | 4 | 1 | 1 | 1 | 2 |
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| 57574 | 830526 | 10 | 13 | 1 | 1 | 1 | 1 | 99 | 0 | 1 | 0 | 2 | 3 | 4 | 6 | 7 | 9 | 10 | 9 | 9 | 9 | 8 | 6 | 3 | 1 | 1 | 1 | 0 |
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| 57574 | 840809 | 11 | 14 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 5 | 6 | 7 | 8 | 9 | 11 | 11 | 8 | 4 | 3 | 3 | 2 | 0 | 0 | 0 |