EVALUATION OF A SHORT TERM OXIDANT CONTROL STRATEGY

FINAL REPORT

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CHAPTER I

INTRODUCTION

An air basin can be viewed as a large chemical reactor into which man pours pollutants from automobiles and industry and which nature irradiates, heats and stirs with the sun and winds. These pollutants react under the influence of meteorology to form what is commonly known as "smog," an air mixture characterized by its color, odor, tendency to irritate the eye and ability to damage plants. Since the discovery of the basic chemistry of photochemical smog in the 1950's, chemists and meteorologists have been unraveling the complex set of interactions between primary pollutants (those emitted directly into the atmosphere by man) and meteorological variables such as temperature and wind speed which result in the formation of photochemical oxidant. A better understanding of these processes is necessary for the design of effective air pollution controls.

Oxidant air pollution, composed mainly of ozone, is the result of a complex series of chemical reactions stemming from reactive hydrocarbon (RHC) and nitrogen oxide (NO_x) emissions. One complicating factor is the non-linearity of the reactions resulting in the formation of photochemical oxidant, such that a change in emissions by a certain percentage does not necessarily lead to the same percentage change in oxidant produced, nor even, as we shall see, a change which is necessarily in the same direction. The prevailing westerly winds provide a second complicating factor. Oxidant measured in one location need not be the product of the emissions in that area, but is more likely the product of emissions which have reacted to form oxidant as they traveled from a location many kilometers upwind. Thus both photochemical reactions and meteorology must be considered in order to gain an understanding of the processes which lead to the formation of photochemical oxidant. In order to evaluate the oxidant air quality impact of various policies, the relationship between ambient oxidant levels and precursor emission levels must be known. Attempts to determine this relationship have followed three general approaches: smog chamber modelling, mathematical simulation of physical and chemical processes, and statistical modeling based on aerometric data.

The size and inhomogeneity of the air basin make it difficult to study. One direction of research uses the smog chamber, a large reaction vessel of several cubic meters volume as a model for the atmosphere. Initial reaction mixtures vary from carefully measured two or three component mixtures of RHC and NO_x to actual auto exhaust. These mixtures are irradiated by light sources which mimic the spectrum of the sun, while sampling devices monitor concentrations of reaction mixture components. Reaction rates and products can thus be determined. By altering the amounts of RHC and NO_x in these experiments, information can be gained on the dependence of oxidant on precursor levels. Smog chambers have provided much of the current understanding of photochemical air pollution. However, questions remain as to how closely smog chambers represent real atmospheric conditions. It is difficult to simulate real meteorology in smog chambers and the hydrocarbon mix may differ from that in the real atmosphere. Also, wall effects in smog chambers produce effects which are absent in real atmospheres, and conversely do not reproduce the real effects of terrestrial surfaces. In addition, smog chamber results do not simulate the spatial distribution of emissions in a region.

The second approach, deterministic or mechanistic modelling of chemical and meteorological processes, involves mathematical simulation of emission patterns, diffusion and mixing, transport and atmospheric chemistry. Such deterministic models could, in principle, explicitly account for the effects of changes in the spatial and temporal distribution of emissions as well as changes in overall emission levels and meteorological variability. Much work has been done in developing and testing chemical/meteorological models, but serious questions still remain concerning the accuracy of such models in predicting the impact of future emission changes. These questions stem from our insufficient understanding of turbulent mixing and diffusion, uncertain knowledge of the rates for atmospheric reactions and inadequacies in the available meteorological data. The application of chemical/meteorological models may also be limited by the expense associated with the extensive data base and the computer time required to run them.

Another method for investigating the chemical properties of the air basin reactor, statistical analysis and modelling, utilizes existing air monitoring data. Statistical studies of these data can yield information about both the chemical reactions and the motion of pollutants in space and time. Statistical models have the advantage that the influences of all complex atmospheric processes are inherent in the aerometric data base which forms the foundation of these models. Conversely, they are also limited by the extent of this data base.

The existing data base is extensive, approximately 2,000,000 numbers representing chemical and meteorological data being available for the present study. Measurements of the various pollutants, both those directly emitted and those formed in the atmosphere by photochemical reactions, have been made for many years, 24 hourly averaged measurements per day, at several locations in the South Coast Air Basin. Similar data are available for several meteorological variables. For Los Angeles County this data base dates back to the early 1950's. More recently, other locations in the South Coast Air Basin have begun collecting similar data. Measurement techniques have changed over the years, and it is not clear that the early data can always be compared directly with recent data. Thus we have chosen to use data for the years 1965-1973 to study the chemical patterns that exist.

Our initial study of the data shows quite unexpected results. An analysis of pollutant data for individual days of the week shows that while average ambient concentrations of the primary pollutants drop significantly on weekends due to decreased emissions, there is no corresponding drop in average concentration of oxidant, the product of the photochemical reactions. This seems counter-intuitive, since one normally expects the products of a series of reactions to decrease if the concentrations of all the precursor compounds decrease. Further work indicates that this phenomenon is reversed in some areas of the air basin during some seasons. These results are discussed in Chapter II.

Many control strategies have been proposed to decrease ambient oxidant levels, some to decrease emissions of pollutants in the long run and others for short term control of episodes with very high oxidant concentrations. Several control strategies attempt to alter transportation habits. Such long term schemes include changing commuter patterns, special bus lanes, and enforced car-pooling. Short term controls usually include a temporary but significant decrease in automobile (and/or industrial) emissions for the duration of an episode or when an episode is forecast. A better understanding of the weekday-weekend differences is an effective tool to evaluate short term control strategies by determining under what circumstances a change from weekday-type emissions to weekend-type emissions will result in a decrease of oxidant concentrations.

We develop models which allow us to predict the effects of implementing this weekend control strategy and determine that there exists a subset of days and areas definable in advance for which this strategy would significantly decrease the oxidant maximum hourly value. Fortunately these days and areas are just those for which such a strategy would be most useful, i.e., those of high oxidant concentration. The effect of continuing the strategy for one or two days is considered; usually the decreases for two days are somewhat larger than those if the strategy is only implemented for one day. The results of these studies are described in Chapter III.

Several linear regressions models were developed in a further attempt to understand the weekday-weekend phenomenon. The results of this work are discussed in Chapter IV. Chapter V is a detailed description of our entire data base, including data not used in these studies. Chapter VI includes samples of programs used in these studies.

Throughout this work it is assumed that the reader has some knowledge of the meteorological characteristics of the South Coast Air Basin which make it so conducive to the production of photochemical smog: temperature inversions and the land-sea breeze regime. For those readers unfamiliar with these, brief descriptions are given below.

Temperature inversions result when air temperature increases with increasing altitude and occur over 250 days per year in the Basin. These inversions are often caused by the subsidence of the eastern edge of a large anticyclone located over the Pacific Ocean. This air heats with compression as it sinks along the coast. A temperature inversion will be observed between the shielding layer of cold marine air and the adiabatically heated air above, with the lower boundary of the inversion at the cooler temperature of the marine layer and the upper edge at the temperature of the warm subsidence layer. Figure 1 is an illustration of a temperature inversion. As air rises it expands and cools, and continues to rise as long as its temperature is higher than that of the surrounding air. Buoyant forces are no longer acting upon the air parcel when it reaches the warm inversion layer, and the parcel remains below the inversion. Thus an inversion serves as an effective "lid" on the air basin, since it prevents mixing of the polluted lower layer with the air above the inversion and forces the pollutants to remain near the surface. The inversion is broken if the ground level air warms to the temperature of the subsided air.

Land and sea breezes result from the different heating and cooling rates of the land and the ocean. In the morning the land heats much more rapidly than the ocean. Heating of the air above the land causes it to ascend because of its decreased density and the cold and denser ground level sea air moves inland to take the place of the rising air. This initiates the sea breeze, which is the prevailing condition in the South Coast Air Basin during the day and early evening. The situation reverses at night because the land cools at a faster rate than the ocean, setting up a convective cell with the reverse direction of the daytime regime. The nighttime land breeze is usually not as strong as the daytime sea breeze. A set of average ground level wind streamlines for the sea breeze (12:00-18:00) and the land breeze (0:00-5:00) is shown in Figure 2.

FIGURE 1

Schematic of a coastal temperature inversion.

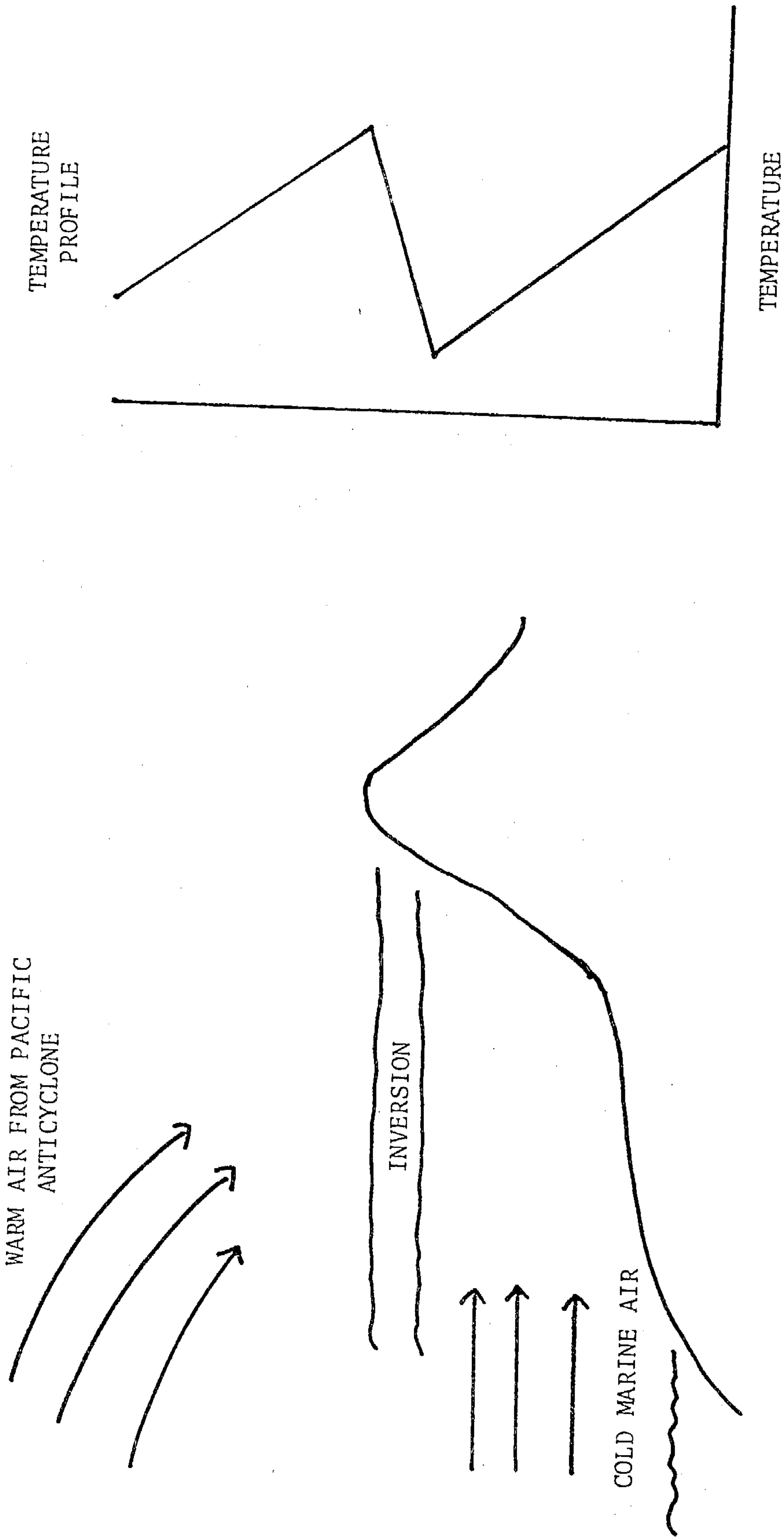
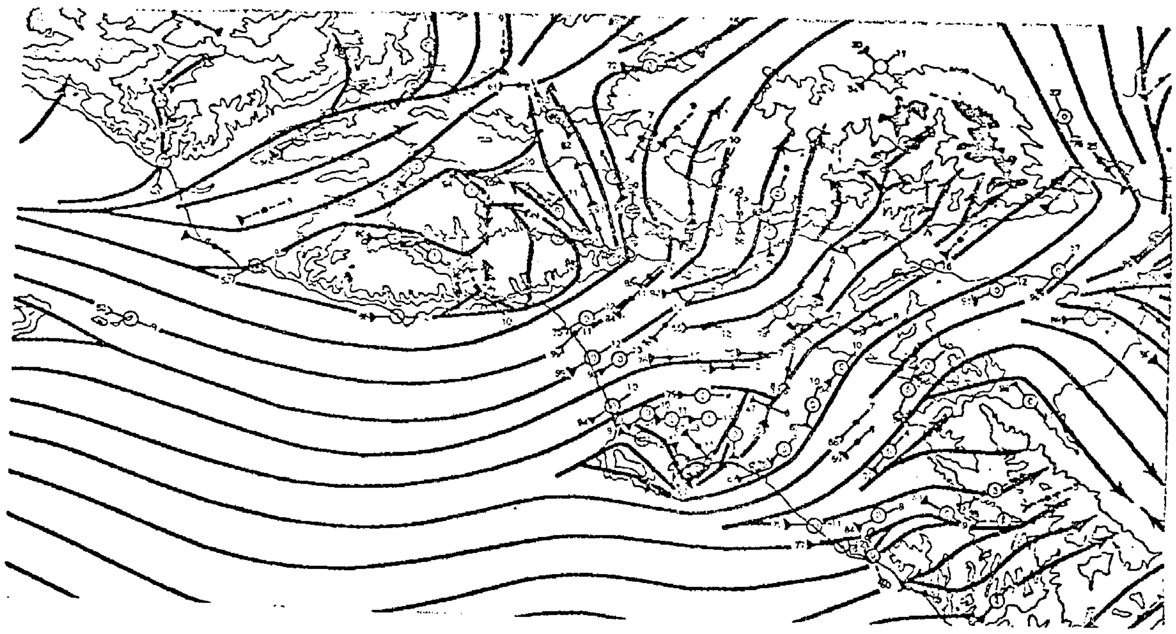
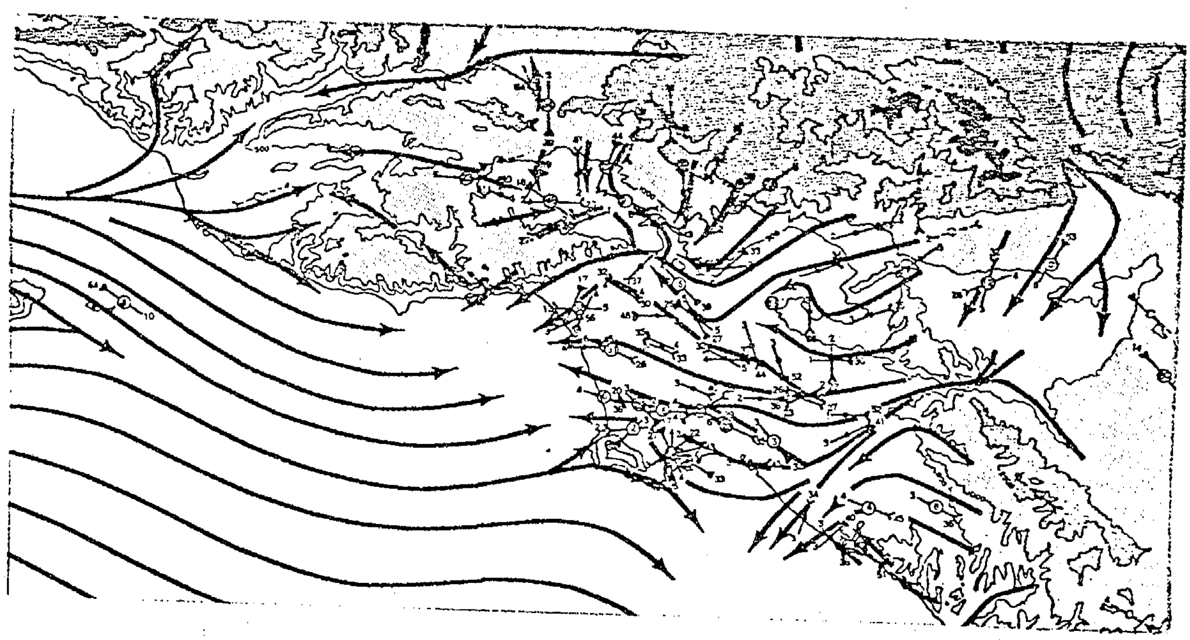

TEMPERATURE
PROFILE
TEMPERATURE
WARM AIR FROM PACIFIC
ANTICYCLONE
INVERSION
COLD MARINE AIR

FIGURE 2

Average wind streamlines for the South Coast Air Basin and surrounding areas. Upper panel shows the streamlines for July, 1200-1800 PST and lower panel shows streamlines for July, 000-500. (Taken from DeMarrais, G. A., Holzworth, G. C. and Hosler, C. R. Meteorological Summaries Pertinent to Atmospheric Transport and Dispersion Over Southern California, Technical Paper No. 54, U. S. Department of Commerce, Washington, D. C., 1965.



Streamline chart for July, 1200-1800 PST



Streamline chart for July, 000-500 PST

CHAPTER II

PHOTOCHEMICAL AIR POLLUTION: WEEKEND-WEEKDAY DIFFERENCES

ABSTRACT

On weekends in Los Angeles County the average atmospheric concentrations of the primary reactants, NO and reactive hydrocarbons, leading to photochemical air pollution decrease. The behavior of oxidant concentration (used as a measure of the products of the photochemical reactions) usually does not follow that of the primary pollutants. In fact, we find that for most of the year the average weekend oxidant concentration is higher than the corresponding weekday value, despite the lowered emissions. However, for areas and times of particularly high oxidant concentration, for example at inland stations during the summer months, the oxidant levels do decrease on weekends. Thus care must be taken when designing short-term oxidant control strategies, as indiscriminant application of short-term traffic decreases to random days could be counterproductive. Such strategies, however, might be useful for days and places of particularly high oxidant concentration and further research to delineate the requisite conditions for the success of such strategies is in process.

INTRODUCTION

An air basin can be viewed as a large chemical reactor stirred by the winds and irradiated by the sun, and may be symbolized as a system with one output responding to two inputs.

When man injects a spatial and temporal pattern of emissions, E, the basin responds (under a particular meteorological regime, M) by producing a spatial-temporal pattern of pollutant concentrations, P. E, M, and P are all functions of three dimensional location, $\underset{\sim}{r}$, and of time, t. Direct experimental measurement of this response function is difficult, both because so many variables and dimensions are involved, and because the investigator has so little control over these variables in a real air basin. One cannot easily stop all traffic or shut down industry in a selected portion of a city.

One can, however, attempt to circumvent these difficultes by a statistical approach which uses the "naturally" occurring variations in E and M and observes the resulting variations in P in order to extract information about the air basin function which links them. For example, one could separate days into sets, each set corresponding to a particular meteorological pattern (1,2) and then observe how the average pollution pattern varies from set to set. Or, one could group days by their emission pattern and study the basin response to emission variation by observing the variation in pollutant pattern among the groups.

In this article we group air quality data by day of the week in order to observe the air basin response to emission pattern differences between weekdays and weekends. On weekends, in contrast to weekdays, i) overall emissions of reactive hydrocarbons (RHC) and oxides of nitrogen (NO_x) are reduced, ii) the 6-9 AM commuter traffic peak is greatly attenuated, and iii) a significant fraction of the already reduced total emissions are shifted into the evening, non-photochemically active, hours. Evidence for these three emission changes can be seen both in traffic patterns and in primary pollutant temporal patterns. These changes are also ones which are natural to consider for short-term oxidant (Ox) control, in an attempt to reduce Ox levels on selected days by temporary emission control. Thus studying the variation of oxidant levels from weekdays to weekends can help evaluate the effects of those control strategies which incorporate similar emissions changes.

The approach of considering weekend-weekday variations was suggested by Haagen-Smit and Brunelle (3) who found fewer extremely high values of oxidant on Sunday in Pasadena, by Hocker (4) who used 1960-61 data and found lower oxidant concentrations on Sunday at all times of the year and by Shuck, Pitts and Wan (5) who used 1962-64 data and observed variations in average maximum daily oxidant values by day of the week, which, while statistically noisy due to the small data set, generally follow the pattern which we observe. Duckworth and Kinosian (6) and Trijonis (7) consider oxidant daily maxima over the summer season, and emphasize a decrease on weekends. As we will show, when the whole year is considered, the picture which emerges is somewhat different. Weekend-weekday variations similar to those we report have also more recently been observed: i) in Los Angeles by Lonneman et al. (8) over a limited three month time period in 1968, as well as more broadly by Tiao and co-workers (9), ii) in the greater New York area by a Bell Laboratories group (10), and iii) by Altshuller (11) for CAMP stations at various locations in the United States.

DATA BASE

In our study the basic pollutant monitoring data are hourly average concentrations by volume of CO (carbon monoxide), NO (nitric oxide), NO_2 (nitrogen dioxide), RHC (reactive hydrocarbons) and Ox (total oxidant, a measure of several oxidizing molecules, largely ozone), obtained from the Los Angeles Air Pollution Control District (LAAPCD). (The concentrations of both total hydrocarbons and methane are actually measured and we used the difference between these two quantities for each hour as RHC.) For CO, NO,

NO_2 and Ox, ten Los Angeles County monitoring stations are used, and their locations are shown in Fig. 1. The data cover the eight years 1965-1972, except for Pasadena, which begins August 1968 and Southeast, which begins August 1969. RHC data are available only from eight of these stations and only for the years 1970-1972. At present there is a discrepancy in oxidant calibration between measurements taken by the LAAPCD and those taken in neighboring counties. A recent study (12) indicates that the LAAPCD measurements differ from the actual oxidant values over the concentration range of the data by nearly a constant scale factor of approximately 0.96. Since all our analysis is based on LAAPCD data and is concerned with relative changes in pollutant levels, the question as to what scale factor is correct does not significantly affect any of our conclusions. Traffic count data are from the California Department of Transportation.

DAILY PATTERNS

Each of the monitored pollutants has its own characteristic daily cycle, as is shown for CO and Ox in Fig. 2. The primary pollutants CO, NO and reactive hydrocarbons (RHC) emitted directly into the air have high concentrations near midnight, a result of the nightly low inversion and light winds. These levels drop off in the early morning, and then begin to rise again, peaking near 8 AM on weekdays as a result of the heavy commuter traffic. Atmospheric instability and decreased traffic (in addition to the photochemically driven processes which use up RHC and NO) decrease primary concentrations during the middle of the day. Late afternoon finds the primary concentrations rising again with increased traffic.

NO_2 is an intermediate pollutant, largely formed in the atmosphere from NO. Its daily pattern is much like that of CO and NO except that its morning peak is later (time is required for the NO to NO_2 conversion). Oxidants, secondary pollutants, are formed in the atmosphere by the action of sunlight on the mixture of primary pollutants (RHC and NO) and normal atmospheric constituents. Thus oxidant concentrations and insolation exhibit similar average behavior: they are low at night and peak near the middle of the day.

Figure 2 shows the hour by hour weekly patterns of CO and Ox, averaged over eight years to remove meteorological "noise," for a coastal, a central and an inland location. Motor vehicle exhaust emission control programs for CO began in 1966 in California. These controls decreased the average vehicle emission levels, but since this affects concentration values at all hours of the day, this changes primarily the scale factors rather than the shapes of the patterns we observe. CO, arising almost entirely from mobile sources, also provides an indicator for mobile source primary emissions of NO and reactive hydrocarbons. A preliminary one-year (1973) study of traffic counts at many Los Angeles County sites indicates that average daily traffic decreases approximately 20% on weekends as compared with weekdays, confirming earlier analyses (4, 7). (One must remember, however, that the relation between emitted mass and measured concentration is in part a function of mixing volume and spatial transport, and that these vary systematically on the average through the day and through the seasons.)

As can be seen, the weekend and weekday structures for CO are quite different, reflecting different traffic patterns. On weekdays, three peaks are usually present: the morning commuter peak A, the afternoon commuter peak B, and the evening build-up C. On weekends total traffic is considerably reduced; commuter peaks are greatly attenuated on Saturday and virtually eliminated on Sunday. While CO shows distinctly different diurnal patterns on weekdays and weekends, oxidant shows a temporal pattern which is almost independent of day of the week. The fine structure of man's time of injection of primary pollutants into the atmosphere is thus integrated out, at least on the average, by the meteorological and chemical processes which transform primary pollutants into secondary species. (An exception is a small dip at the beginning of most weekday, but not weekend, average Ox peaks, corresponding to the time of the CO morning commuter peak. This dip is likely due to removal of ozone by emitted NO.)

RESULTS AND DISCUSSION

Figure 2 illustrates the oxidant time response, averaged over meteorology, to time variation of emission input. Figures 3 and 4, in contrast, illustrate oxidant level response, showing 24 hour average pollutant levels for each day of the week at ten LAAPCD monitoring stations and the average daily hourly maximum for oxidant.

A major source of the primary pollutants is the automobile. Since there is a large decrease in automobile traffic on weekends (4, 7), it is to be expected that pollutant concentrations will also decrease on weekends. Again, it is important to note that while emission controls have been implemented during this time, they alter emissions on all days of the week equally.

Figure 3 shows the weekend drop in the annual daily average concentrations of the primary pollutants CO, NO and RHC, and of the largely secondary pollutant NO_2. Although the average daily concentrations of these pollutants show significant seasonal variation due to differences in meteorological regimes, similar concentration drops are observed during all seasons of the year.

Since the evidence indicates that average emission levels of primary reactants drop on weekends, it is surprising to observe in Figure 4a that the average oxidant levels rise on weekends at all ten stations. While the ten station weekend average CO drops by 7%, NO by 12%, NO_2 by 9% and RHC (eight stations, 1972-72) by 24%, in contrast the ten station oxidant average rises by 8%. Error bars show ± one standard deviation of the mean, calculated from the central limit theorem, on the basis of one measurement per day with the assumption that the measurements made one week apart are independent. The autocorrelation function indicates that this assumption of statistical independence is realistic. Among the variations contributing to these standard deviations are actual concentration changes, random measurement error and measurement round-off. For the daily averages the error bars shown are somewhat too large, because there is also a partial independence among the 24 hourly measurements pre-averaged to form the day's average value. Thus the weekend-weekday differences shown are statistically valid unless there is an unrecognized systematic variation in the LAAPCD measurement procedures between weekends and weekdays. The weekend-weekday patterns remain essentially the same even if only the three more recent years 1970-1972 are considered, CO dropping by 12%, NO by 13.2%, NO_2 by 11%, RHC by 24% and the oxidant average rising by 11%, but the standard deviation of the mean is of course larger due to the smaller sample size. The differences still remain statistically valid. Thus, while the average atmospheric concentrations of the reactants leading to photochemical air pollution, NO and RHC, decrease on weekends, the average concentration of products of the photochemical air pollution reactions, as monitored in terms of total oxidant, increases on weekends.

These results are corroborated by a further statistical analysis, shown in Tables I and II, of the fractional change between the weekday and weekend concentrations for each week, found by calculating the mean concentration on Saturday and Sunday (Weekend) and the mean concentration of the five weekdays (Weekday) and then calculating the fraction (Weekend-Weekday)/Weekday. The median of this fractional change is used as a more robust measure of the central tendency than the mean because it is not as affected by a few outlying values (13). These medians exhibit the same pattern as the day by day means shown in Figures 3 and 4. For all of the primary pollutants and NO_2, as shown in Table I, there is a large fractional decrease of pollutant concentrations on weekends at most stations which is statistically significant at the 95% confidence level. For oxidant concentrations covering the whole year, these median values, given in column 1 of Table II, show a statistically significant increase in oxidant concentrations on weekends at most stations, which is confirmed at the 95% confidence level, as shown in column 2.

Applying a more stringent statistical test, the 95% confidence upper limit of median primary pollutant change rarely even overlaps the 95% confidence lower limit of median oxidant change. For primary pollutants and NO_2 the median fractional concentration change is listed for each station along with the one-tailed 95% confidence upper limit for the median. The upper limit is presented since the important quantity is the median weekend fractional drop for primary pollutants, and this is expected with 95% confidence to be at least as great as the upper limit shown. The one-tailed 95% confidence lower limit is used for oxidant since it is the maximum decrease (or minimum increase) of oxidant on weekends that is of interest for the comparison of primary and oxidant behavior. The primary, NO_2 and oxidant data are presented both for the three years 1970-1972 and for the eight years 1965-1972. Similar patterns are observed for both time periods and for other time periods, although the medians for longer data periods naturally have more precision in terms of confidence limits.

Seasonal variations in the pattern of weekday-weekend differences for oxidant, in contrast to the other pollutants, are significant. When the data are segregated by season, increased oxidant on weekends is observed at all stations during the fall, winter, and spring. However, as is shown in Figure 4b, during the summer high smog season, half of the stations (those further inland with higher average oxidant levels) show decreased average daily oxidant on weekends. Similarly, the median value of the fractional change of the summer average oxidant concentration on weekends shows that the coastal stations tend to have an increase on weekends, while the inland stations tend to have decreased weekend oxidant concentrations. These are listed, with the 95% confidence limits, in column 3 and 4 of Table II.

In addition to the average or mean dosage examined above, other measures of the distribution of oxidant concentration values may also usefully be considered. The daily hourly maximum, for example, is the highest of the hourly average values reached in a particular day, and over a year samples the higher values of the total distribution of oxidant values. As can be seen in Figure 4c, increased weekend oxidant values occur for coastal stations with lower oxidant levels, and variable trends are seen for inland stations. Table II (columns 5 and 6) shows the corresponding fractional changes in concentration. If, as in Figure 4d and columns 7 and 8 of Table II, the data are further restricted to the daily maximum over only the summer high smog season, the oxidant values generally decrease on weekends, with the decrease most marked at stations with the highest values. A still more restricted sample from the oxidant distribution may be examined by looking at only oxidant alert days (when oxidant values reach 0.50 ppm): no Los Angeles County alert has ever been called on Sunday, and alerts are much less frequent on Saturday (4, 14). Thus, while the mean and the median of the fractional change of the entire oxidant distribution both increase on weekends, it appears that as one restricts the sample to successively higher values drawn from the distribution, the weekend increase becomes less pronounced and then finally becomes a decrease.

CONCLUSION

A definitive chemical-meteorological explanation of these observations will require further study. Two types of mechanisms might be involved: feedback within the chemical kinetics and meteorological carryover from one day to the next.

NO rapidly attacks ozone, and thus the increase of reactant NO emissions on weekdays could conceivably decrease the average product ozone, particularly if the NO/RHC ratio varies by day of the week. Lonneman et al. (8) suggest that the NO_2/NO ratio may differ between Sundays and weekdays.

Persistence of unmonitored partially reacted intermediates from earlier days or of ozone aloft might also be involved, such that the chemical-meteorological dynamics of the air basin must be analyzed on more than an isolated day basis. Thus changes in the daily injected dosage of emitted reactants could perhaps produce transient product concentration behavior which initially moves counter to the expected longer term effect.

These observations indicate that short-term control strategies which aim to reduce oxidant levels on particular days by temporary daily reductions in emissions levels need to be implemented with care if they are to be effective. Controls which mimic weekend emissions changes would be counterproductive if applied to random days. Fortunately, it appears that the days and locations of highest oxidant levels are likely to be those for which such a strategy would be productive, and further research to delineate the proper conditions and the expected results of such strategies is in progress.

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Table I. Median Fractional Concentration Drop on Weekends for Primary Pollutants

Station	No. of yrs[a]	CO 1 Median	CO 2 Upper limit (95%)	NO 3 Median	NO 4 Upper limit (95%)	NO_2 5 Median	NO_2 6 Upper limit (95%)	RHC[b] 7 Median	RHC[b] 8 Upper limit (95%)
Downtown	3	-0.24	-0.19	-0.31	-0.19	-0.26	-0.21	-0.59	-0.42
	8	-0.14	-0.12	-0.23	-0.19	-0.26	-0.22		
Azusa	3	-0.09	-0.06	-0.17	-0.10	-0.16	-0.10	-0.47	-0.37
	8	-0.04	-0.02	-0.13	-0.07	-0.14	-0.11		
Burbank	3	-0.17	-0.13	-0.12	-0.04	-0.17	-0.09	-0.35	-0.25
	8	-0.09	-0.07	-0.08	-0.03	-0.17	-0.12		
West Los Angeles	3	-0.11	-0.06	-0.08	0.00	-0.12	-0.04	--	--
	8	-0.05	-0.03	-0.08	-0.02	-0.06	-0.03		
Long Beach	3	-0.16	-0.13	-0.19	-0.10	-0.11	-0.03	--	--
	8	-0.08	-0.06	-0.14	-0.10	-0.07	-0.03		
Reseda	3	-0.05	-0.02	--	--	-0.03	0.00	-0.45	-0.34
	8	-0.04	-0.02	--	--	-0.04	-0.01		
Pomona	3	-0.09	-0.04	-0.03	0.00	-0.08	-0.04	-0.86	-0.56
	8	-0.04	-0.02	-0.04	-0.01	-0.08	-0.04		
Lennox	3	-0.20	-0.12	-0.24	-0.15	-0.15	-0.07	-0.59	-0.33
	8	-0.09	-0.07	-0.24	-0.20	-0.09	-0.04		
Pasadena	3	-0.17	-0.13	-0.17	-0.11	-0.14	-0.10	-0.40	-0.23
	8	-0.08	-0.06	-0.18	-0.13	-0.11	-0.07		
Whittier	3	-0.11	-0.06	-0.15	-0.06	-0.13	-0.03	-0.44	-0.27
	8	-0.07	-0.05	-0.18	-0.12	-0.10	-0.05		

[a]Data for three years (1970-1972) and eight years (1965-1972).

[b]RHC data only for the three years 1970-1972 and at eight stations.

Table II. Median Fractional Concentration Change on Weekends for Oxidant

Station	No. of yrs[a]	Oxidant average entire year 1 Median	Oxidant average entire year 2 Lower limit (95%)	Oxidant average summer 3 Median	Oxidant average summer 4 Lower limit (95%)	Oxidant maxima entire year 5 Median	Oxidant maxima entire year 6 Lower limit (95%)	Oxidant maxima summer 7 Median	Oxidant maxima summer 8 Lower limit (95%)
Downtown	3	0.13	0.06	0.01	-0.01	0.21	0.02	0.00	-0.07
	8	0.08	0.02	-0.01	-0.07	0.02	-0.02	-0.07	-0.12
Azusa	3	0.05	-0.01	-0.05	-0.11	-0.02	-0.10	-0.11	-0.18
	8	0.04	0.00	-0.07	-0.13	-0.02	-0.08	-0.11	-0.17
Burbank	3	0.03	-0.01	-0.07	-0.09	0.01	-0.09	-0.12	-0.22
	8	0.02	-0.02	-0.08	-0.11	-0.07	-0.10	-0.12	-0.16
West Los Angeles	3	0.09	0.06	0.04	-0.06	0.11	0.00	-0.03	-0.13
	8	0.07	0.04	0.05	0.00	0.04	-0.03	0.04	-0.06
Long Beach	3	0.08	0.00	0.11	-0.01	0.00	-0.07	-0.02	-0.10
	8	0.06	0.03	0.06	-0.01	0.01	-0.02	-0.02	-0.09
Reseda	3	0.03	-0.03	-0.03	-0.17	-0.02	-0.08	-0.10	-0.17
	8	0.01	-0.03	-0.06	-0.13	-0.05	-0.08	-0.12	-0.19
Pomona	3	0.06	0.02	0.03	-0.12	0.01	-0.06	-0.09	-0.17
	8	0.05	0.01	0.01	-0.12	0.01	-0.04	-0.07	-0.16
Lennox	3	0.15	0.12	0.14	0.01	0.18	0.08	0.14	0.03
	8	0.13	0.10	0.14	0.03	0.11	0.07	0.13	0.02
Pasadena	3	0.06	0.01	0.02	-0.06	0.00	-0.06	-0.08	-0.18
	8	0.08	0.02	0.02	-0.03	0.03	-0.01	-0.05	-0.10
Whittier	3	0.09	0.02	-0.01	-0.04	0.04	-0.03	-0.02	-0.13
	8	0.10	0.04	0.02	-0.02	0.06	0.00	0.02	-0.07

[a]Data for three years (1970-1972) and eight years (1965-1972).

FIGURE 1

Locations of Los Angeles Air Pollution Control District (LAAPCD) stations from which data were used for this study.

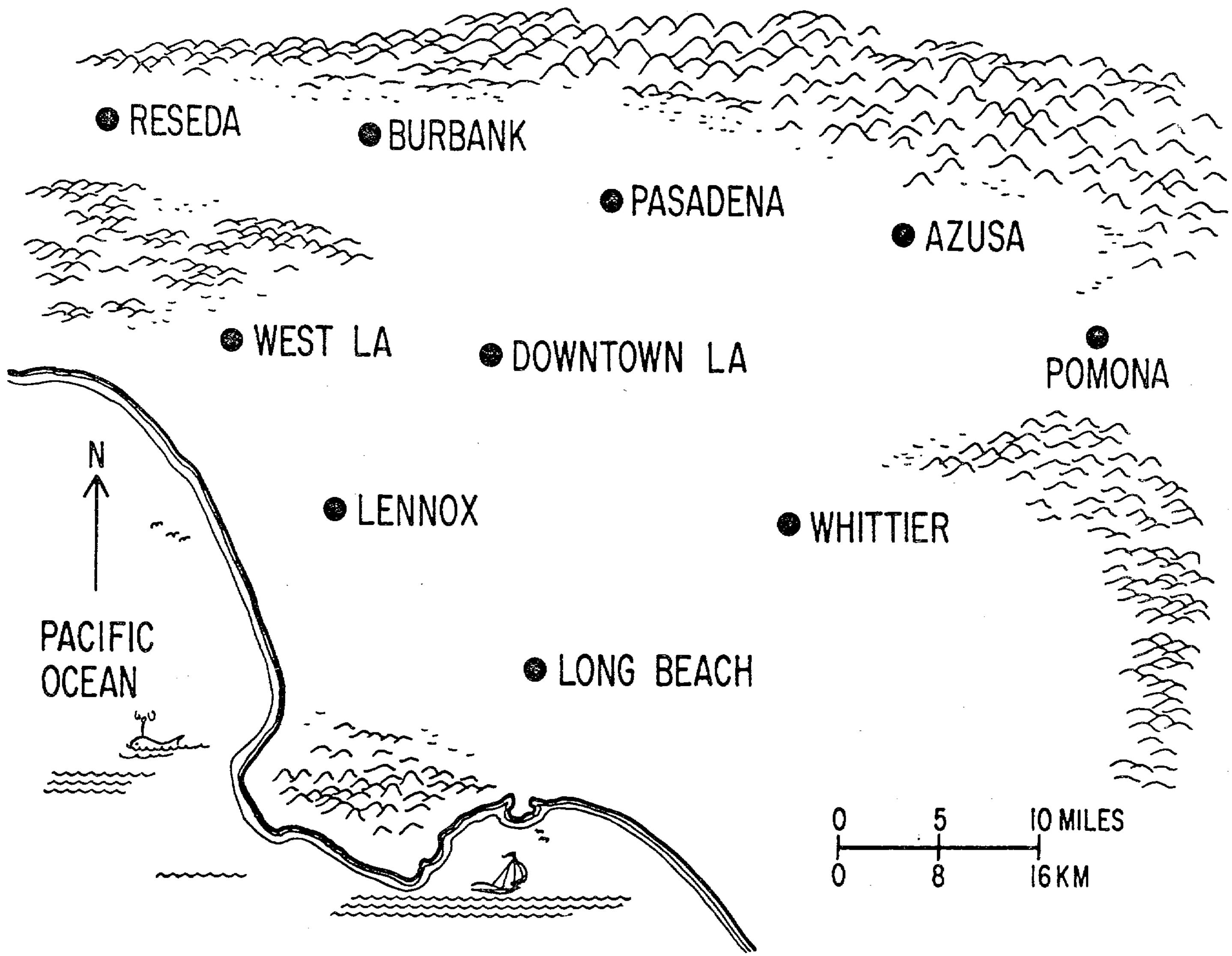
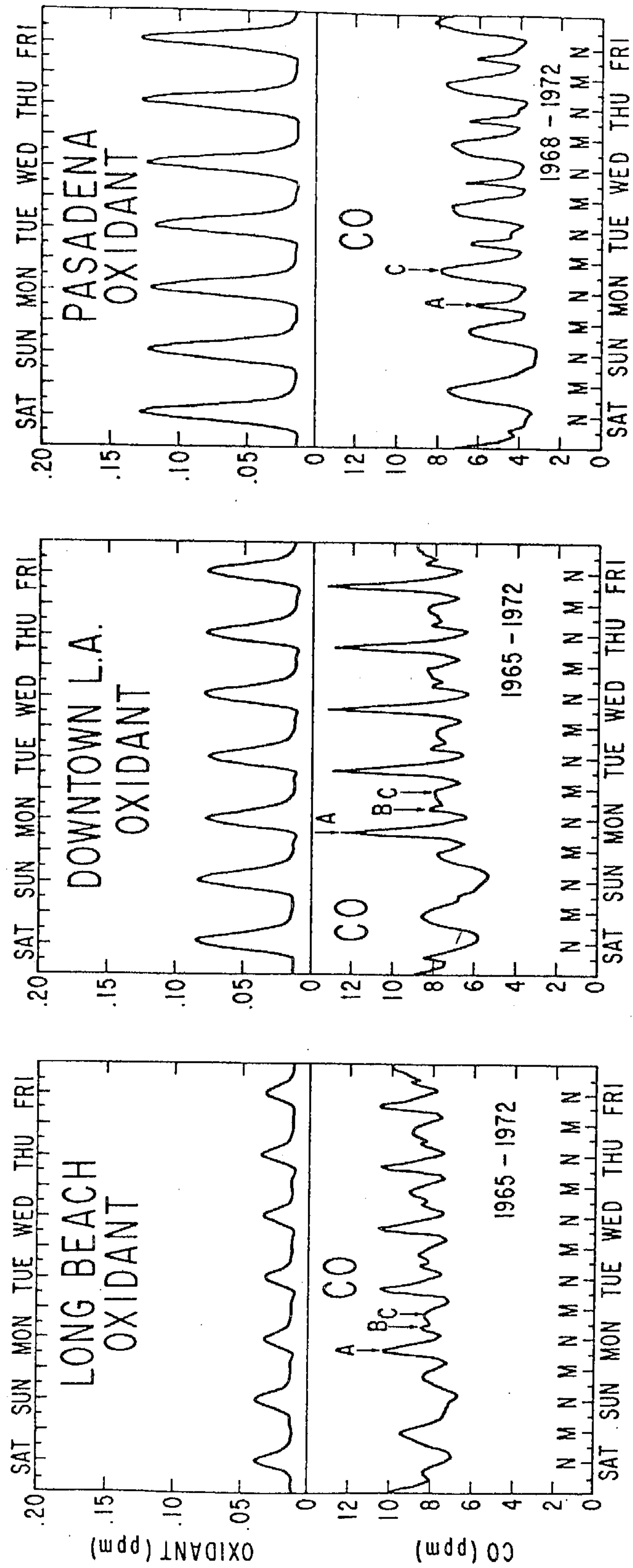

RESEDA
BURBANK
PASADENA
AZUSA
WEST LA
DOWNTOWN LA
POMONA
N
LENNOX
WHITTIER
PACIFIC
OCEAN
LONG BEACH
0 5 10 MILES
0 8 16 KM

FIGURE 2

The weekly pollutant concentration pattern averaged hour by hour over 1965-1972 for CO (carbon monoxide) and for total oxidant. Pollutant concentrations are in parts per million (ppm) by volume. Oxidant exhibits a single symmetrical daily peak at midday. CO has several structural features. **A** is the morning commuter peak, **B** the smaller afternoon commuter peak, and **C** the evening and nightly concentration rise. Three types of stations are illustrated: a) Long Beach, a coastal station with high CO and low oxidant concentrations, b) Downtown Los Angeles, a central station with high CO and moderate oxidant concentrations, and c) Pasadena, an inland station with low CO and high oxidant concentrations.


LONG BEACH
OXIDANT
CO
1965 - 1972
DOWNTOWN L.A.
OXIDANT
CO
1965 - 1972
PASADENA
OXIDANT
CO
1968 - 1972
A
B
C
SAT SUN MON TUE WED THU FRI
OXIDANT (ppm)
CO (ppm)

CHAPTER III

A TESTED SHORT-TERM OXIDANT CONTROL STRATEGY

ABSTRACT

A possible short term oxidant control strategy would involve i) reduction of overall reactive hydrocarbon and NO_x emissions, ii) restriction of morning commuter traffic and iii) a shift of emissions into the evening and nighttime photochemically inactive hours. Since these represent the emissions alterations which usually mark the change from weekdays to weekends, the actual effects of such a strategy can be evaluated in advance from statistical studies of past weekday-weekend differences in monitored oxidant levels. As a test, we have used data from the South Coast Air Basin in the Los Angeles area. Results presented earlier have shown that switching to a weekend emissions pattern on random days would be counterproductive, i.e., oxidant levels would on the average increase. In this paper we demonstrate that there exists a definable subset of conditions under which switching to weekend emissions would significantly decrease average oxidant levels both one and two days into the future. Fortunately, this strategy works best just when it is most needed, under conditions of particularly adverse oxidant levels.

INTRODUCTION

Various short term oxidant control strategies are proposed to limit the severity of episode days and the statistical aspects of models for such episode control strategies are discussed in a recent review (Myrabo et al., 1976). The problem with most such strategies is that in the face of meteorological variability it is difficult to predict in advance what the actual effect will be or even assess the effect after the strategy has been tried out. There is one short term oxidant control strategy which can be tested by analysis of existing data: the effect of the selective reduction and redistribution of reactive hydrocarbon and NO_x emissions which occurs on weekends versus weekdays. Three changes in emissions pattern usually distinguish weekends from weekdays: i) overall traffic is reduced, ii) the morning commuter traffic peak is reduced and iii) traffic is shifted into the evening and nighttime photochemically inactive hours.

On weekends throughout the year in Southern California there is a significant decrease in vehicle miles traveled, resulting in a sizeable reduction in the average emission of vehicular NO_x and reactive hydrocarbons (Elkus and Wilson, 1976). This decrease in turn produces lower average primary pollutant concentrations in the atmosphere of the South Coast Air Basin which includes Los Angeles County. On the whole industrial emissions probably also decrease on weekends. Thus we observe a significant reduction in average primary pollutant concentrations of CO, NO and reactive hydrocarbons on weekends in the Los Angeles area (Elkus and Wilson, 1976). Evidence from analyses of the observed weekend-weekday variation in average oxidant levels in Los Angeles (Elkus and Wilson, 1976; Tiao et al., 1975) as well as other major metropolitan areas (Lonneman et al., 1974; Bruntz et al., 1974) indicates that if applied to random days, a strategy which converts weekday emissions to those of a weekend would not decrease average oxidant dosage, but in fact would quite likely raise it. We present evidence here, however, that there exists a subset of days and areas for which this strategy would work, and that these days and areas are usually those for which such a strategy would be most useful, i.e., those of high oxidant concentration. We present further analyses of the Los Angeles data which allow selection of those days and areas for which such a strategy would be effective and we statistically predict the numerical average value of the effect of the strategy, station by station, as a function of initial oxidant level and month of the year. The effects of continuing the strategy for one or for two days are separately considered. The largest average decreases occur i) at inland stations with higher average oxidant levels, ii) during the summer and early fall high smog season and iii) following episode days of particularly high oxidant level.

DATA BASE

The basic pollutant monitoring data for this study are hourly average concentrations by volume and the daily hourly maxima of oxidant, obtained for Los Angeles County from the Los Angeles Air Pollution Control District (LAAPCD) for the years 1966 through 1972, and from the California Air Resources Board (CARB) for 1973. Data for stations outside Los Angeles County are obtained from the CARB, and meteorological data are from the LAAPCD and the National Weather Service. Ten Los Angeles County monitoring stations are used, with data covering the eight years 1966-1973 except for Pasadena which begins August 1968 and Whittier which begins August 1969. Three CARB stations are used: the data for San Bernardino cover the full eight years, for Riverside only 1966-1971 and for Redlands only 1968-1972. There has been a discrepancy in oxidant calibration between measurements taken by the LAAPCD and those taken in neighboring counties. A recent study indicates that the LAAPCD measurements differ from the actual oxidant values over the concentration range of the data by nearly a constant scale factor of 0.96 and that the other measurements differ from the actual oxidant values by the scale factor of 1.28 (California Air Resources Board, 1975; Stephens and Winer, 1976). We have adjusted our data accordingly. Locations of the stations used in this study are shown in Figure 1.

RESULTS

We use the day of the year t and the day's maximum hourly oxidant concentration to predict the maximum hourly oxidant concentration at day $t + 1$. For each station, using all the data for 1966-1973 (except as noted above), we fit surfaces of the form:

$$Ox_{t+1} = a_1 + a_2 Ox_t + a_3 \cos(2\pi t/365) + a_4 \sin(2\pi t/365)$$
$$+ a_5 Ox_t \cos(2\pi t/365) + a_6 Ox_t \sin(2\pi t/365) + a_7 (Ox_t)^2 \quad ,$$

where $a_1, \ldots, a_7$ are the parameters to be fitted, t is the day of the year, and Ox_t is the daily hourly oxidant maximum for day t. Trigonometric terms are used to insure proper yearly periodicity. Separate surfaces are least-squares fitted for each station to represent two different cases: i) both t and $t+1$ are weekdays, and ii) t is Friday and $t+1$ is Saturday. Surface i) predicts oxidant if today and tomorrow are both weekdays and no short term control strategy is applied other than patience. Surface ii) predicts oxidant on a day with emissions altered to the Saturday pattern. The difference between surfaces i) and ii) measures the effect of a control strategy which changes emissions from a weekday to a Saturday pattern.

In addition, we fit surfaces which predict oxidant maxima two days in advance, the dependent variable in this case being Ox_{t+2}. The first surface is still fitted using only weekday data, t, t + 1 and t + 2 are all weekdays. The second surface fits the data when t is Friday and t + 2 is Sunday. The difference between these surfaces gives the result of implementing a control strategy on two consecutive days such that the first has Saturday's emission pattern and the second has Sunday's.

Figures 2 - 5 show these differences for high smog months as a function of oxidant maximum at two inland stations (San Bernardino and Azusa), at a center city station (Downtown) and at a coastal station (Lennox). The results for implementing the strategy for only one day (t + 1) and the results for continuing the strategy for two days (t + 2) are shown as the solid curves in the middle and upper panels, respectively.

As can be seen in the figures, this control strategy is most effective at inland locations where oxidant values are high. For example, as shown in Figures 2 and 3, San Bernardino drops 18% on day t + 1 and 33% on day t + 2 and Azusa drops 21% on both days t + 1 and t + 2 for episode conditions in August as a result of switching to weekend emissions. Similar results with somewhat smaller August episode oxidant drops of 11% on t + 1 and 14% on t + 2 are observed at Downtown, as shown in Figure 4. At Lennox, on the coast where smog levels are low, the control strategy has little effect, positive or negative, in the summer months as is shown in Figure 5. During low smog months of the year, especially in the winter, it would be detrimental to implement such a short term strategy in the air basin, since its effect is to slightly increase the average oxidant maxima, as can be seen in the results for January at the four stations shown in Figure 6. Thus, felicitously, the strategy works most effectively when and where it is most needed, at times and places of high oxidant levels, and its failures on the whole are conveniently confined to times when it is unnecessary to apply it.

When evaluating a control strategy, one must also consider the effect of implementing no strategy at all. We thus calculate the average decrease in oxidant maxima that would be predicted in the absence of control measures. These results are shown as the dashed lines in Figures 2 - 6. As expected, the quasi-stationary concentration time series tends to return to the mean. Therefore if oxidant maxima are exceptionally low today, the natural tendency of the air basin is toward higher oxidant maxima tomorrow and the next day; on the other hand, when concentrations are exceptionally high today the air basin tends toward lower oxidant maxima tomorrow and the next day, even if no control strategy is implemented. (If today is an episode day, an air pollution control agency can thus predict that tomorrow will be better with the confidence that on the average chemistry and meteorology will conspire to prove it right, and that the worse the episode day, the better are the odds.) The decreases predicted by the solid lines to result from the control strategy are those which occur <u>in addition</u> to the decreases which will occur if no action is taken. Therefore the total expected decrease resulting from control strategy implementation is the sum of the dashed and solid lines.

Similar plots for all months at all stations shown in Figure 1 are available elsewhere (Elkus, 1976). The results are summarized in Figure 1 for all stations in August. The middle panel of Figure 1 shows station by station the predicted average oxidant improvement in parts per hundred million from application of the strategy one day after an episode day in August. The upper panel shows the slightly larger average improvement on the second day predicted by implementing the strategy for two days.

Since the fitted surfaces are nonlinear, it is difficult to precisely determine the proper error to assign to the predicted decreases. In order to estimate this error, we separately fit surfaces to data for each of the eight (or in some cases less, as noted above) years for each of the $t+1$ and $t+2$ cases. As there are fewer data points, the shape of these annual surfaces does not represent the total data as well as the surfaces using all years of the data (and thus the results are less certain for stations with less years of data). We use the resulting annual surfaces to give a measure of the uncertainty in the predictions. The predicted oxidant decrease is calculated separately for each year from these annual surfaces, and the standard deviation of the mean σ_m over all N years of data is then estimated as $\sigma_m = \sigma_a / N^{1/2}$ in which σ_a is the standard deviation over the N different annual results. The error bars in Figures 2 - 6 are $\pm\sigma_m$.

The values of the mean itself, however, are from the surfaces calculated from all N years of data taken together. In addition to the temporal consistency reflected in σ_m, there is a further spatial consistency in that similar effects are usually seen at stations in similar geographical areas.

Additional techniques including linear regression and pattern recognition involving many meteorological variables are also applied to the data base in searching for the best predictive model. Although the simple analysis presented above proves sufficient for short term strategy analysis, stepwise linear regression on a large number of ground and upper air meteorological variables produces interesting results of another sort, providing clues to the statistical correlations between oxidant concentration and meteorological variables (Elkus, 1976). Temperature and insolation are found to correlate best with oxidant level, while relative humidity and seasonal mean oxidant level provide a smaller amount of additional information. Surprisingly, in spite of the general assumption to the contrary, inversion height and wind speed fail to provide further statistically significant information.

Other significant short term changes in the daily emission pattern might also be analyzed for clues to the effectiveness of various short term control strategies such as holidays, natural or man-made disasters and the switch from standard time to daylight time in the spring and the return to standard time in the fall. In the latter case we change our schedules each year and thus the time of most emissions by exactly one hour with reference to the sun. Analysis of the monitoring date for CO, which serves as a measure of traffic emissions since it is chemically relatively inert, shows that the CO morning commuter peak also shifts by one hour: forward in the spring, backward in the fall. Strikingly, this change in the timing of human activity and emissions has little effect on the timing of the midday oxidant peak (no statistically significant effect is found on its peak level). The timing of the processes leading to oxidant production is thus shown to be much more dependent on the timing of the sun than on the time of human injection of emissions into the atmosphere.

CONCLUSION

We show for the Los Angeles area that application of a short term control strategy which substitutes on a weekday emissions patterns resembling those of a weekend will on the average significantly decrease the observed oxidant maxima when and where oxidant concentrations are high. Due to short term fluctuations in meteorology, the predicted decreases calculated from our statistical analysis will not necessarily be observed for any specific application of this short term strategy. Rather, the average effect of its application over several appropriate occasions will be significant improvement in oxidant air quality.

The strategy evaluated here is by no means the only, nor necessarily the best, short term control strategy which might be applied. It is valuable in that its average results can be predicted in advance. Furthermore, the declaration of a midweek holiday under episode conditions might even be met with approval by the populace. Further studies are needed to refine this strategy and to test its effect in areas other than Los Angeles. In addition, the application of this type of strategy to the control of other pollutants can be tested in a similar fashion.

ACKNOWLEDGMENTS

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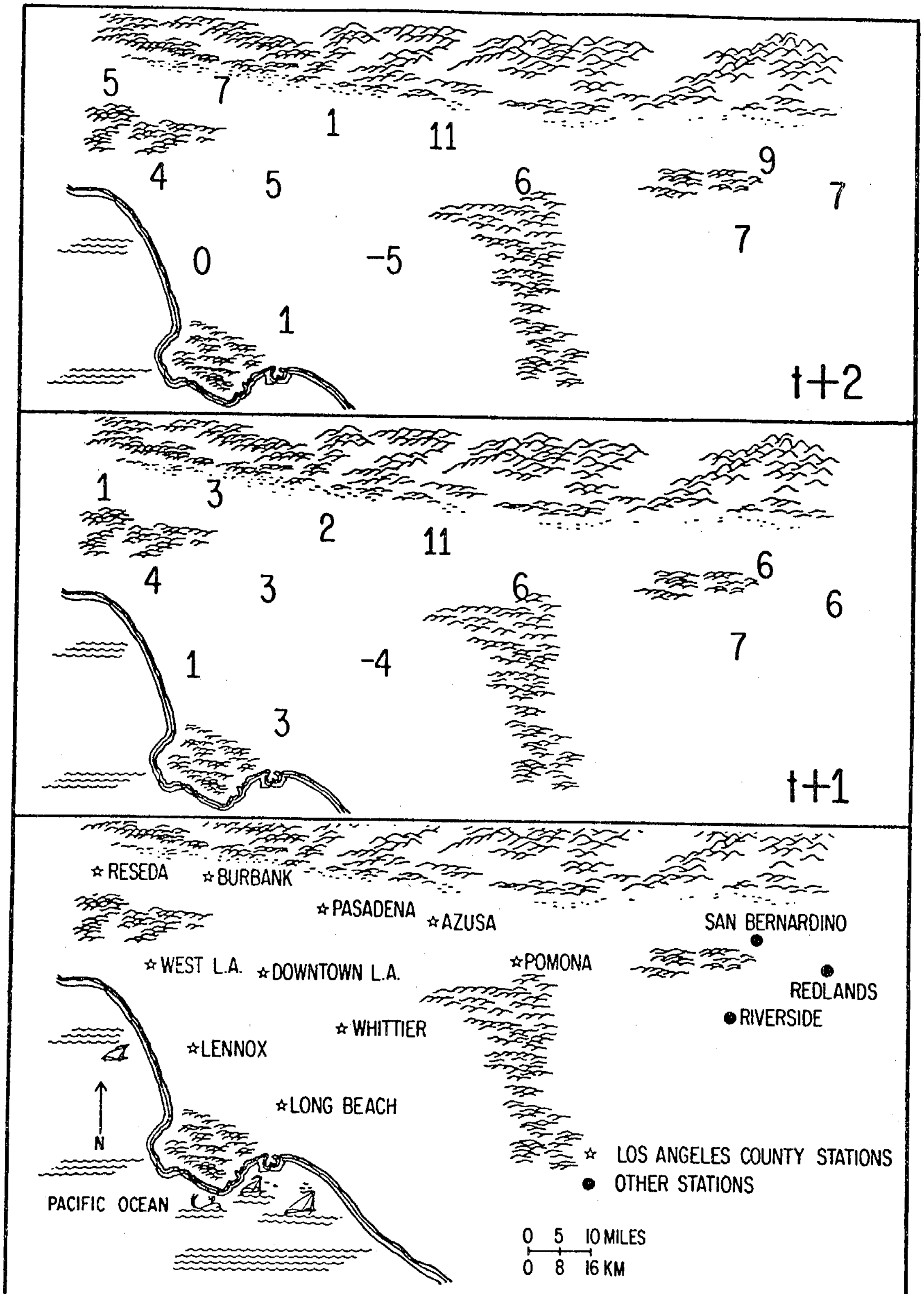
Tiao, G. C., Phadke, M. S. and Box, G. E. P. (1975) Some Empirical Models for the Los Angeles Photochemical Smog Data. Technical Report #412, Department of Statistics, University of Wisconsin, Madison.

FIGURE 1

The effect at various locations in the South Coast Air Basin of a short term control strategy which changes weekday emissions to weekend levels. The numbers, based on past data, indicate the statistically expected average improvement in daily hourly maximum oxidant level (pphm) as a result of switching emissions patterns at episode levels in August. Episode levels in the context of this article are defined as days in which the daily hourly oxidant maximum at that station falls within the highest nonzero box in the percentile distribution for that month as shown in Figures 2 - 6. The middle panel shows the improvement due to applying the strategy for one day, i. e. switching a weekday to Saturday emissions. The upper panel shows the improvement on the second day (t +2) compared to the initial day (t) due to applying the strategy for two days, i. e. switching the first weekday to Saturday emissions and the second to Sunday emissions. The lower panel shows the locations of the monitoring stations used in this study.



AIR MONITORING STATIONS IN THE LOS ANGELES BASIN

FIGURE 2

Average decreases for days t + 1 and t + 2 in daily hourly maximum oxidant concentration for the high smog months of July, August and September at San Bernardino. Decreases are graphed as a function of hourly oxidant maximum for day t. The dashed curves indicate the decreases expected if no control strategy is implemented. The solid curves show the expected additional decrease resulting from the implementation of a control strategy which changes weekday emissions to weekend levels. The middle panel shows the results of implementing such a strategy for one day, t + 1. The upper panel shows the decrease on day t + 2 from day t if the strategy is continued for two days. The error bars are ± one standard deviation of the mean, as estimated from the variation among similar analyses carried out year by year. The lower panel shows the percentile concentration distribution of the actual air monitoring data. Predicted decreases are shown only over the range of the percentile distribution.

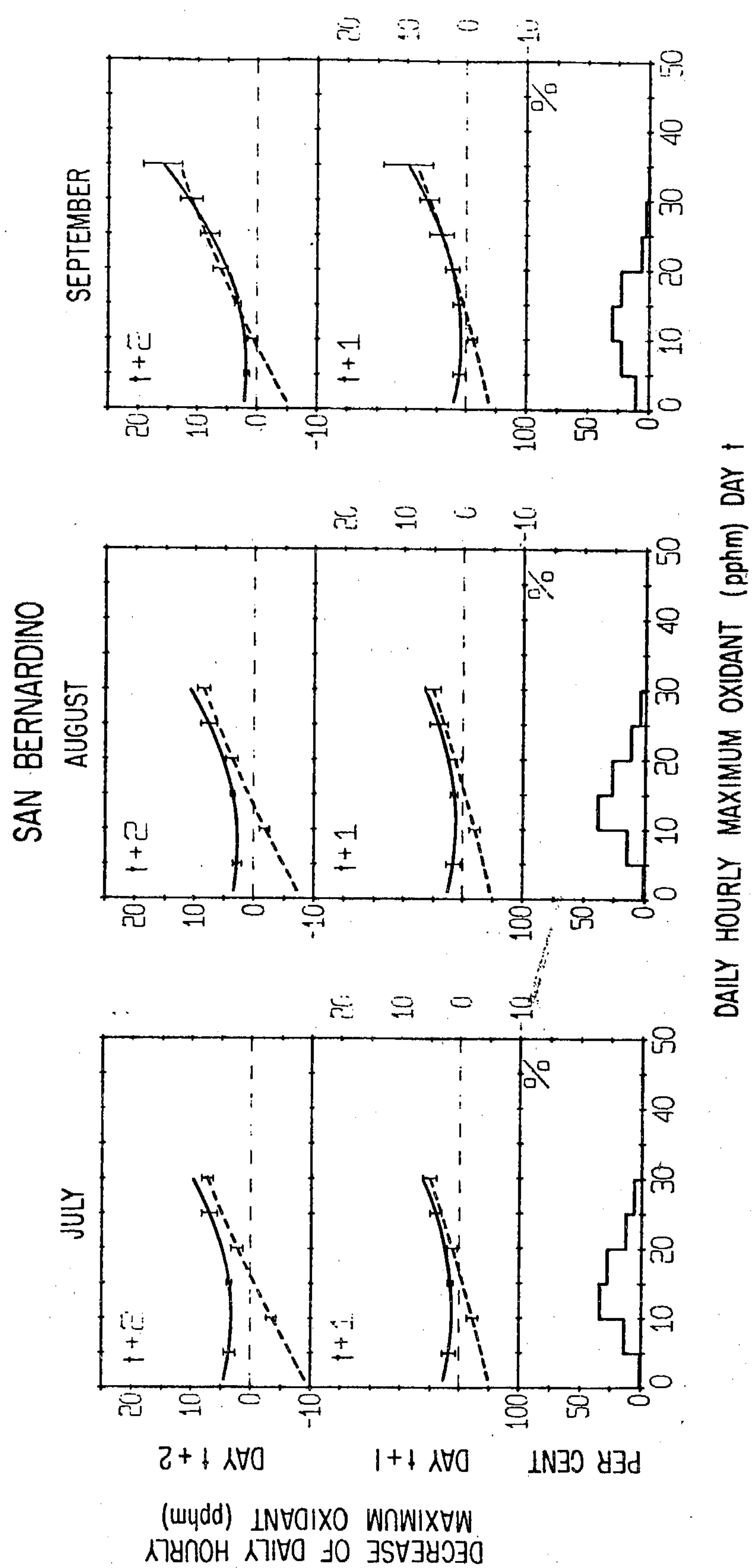

SAN BERNARDINO
JULY
AUGUST
SEPTEMBER
DECREASE OF DAILY HOURLY MAXIMUM OXIDANT (pphm)
DAY t + 2
DAY t + 1
PER CENT
t + 2
t + 1
%
DAILY HOURLY MAXIMUM OXIDANT (pphm) DAY t

FIGURE 3

Average decreases in daily hourly maximum oxidant concentration for high smog months at Azusa.

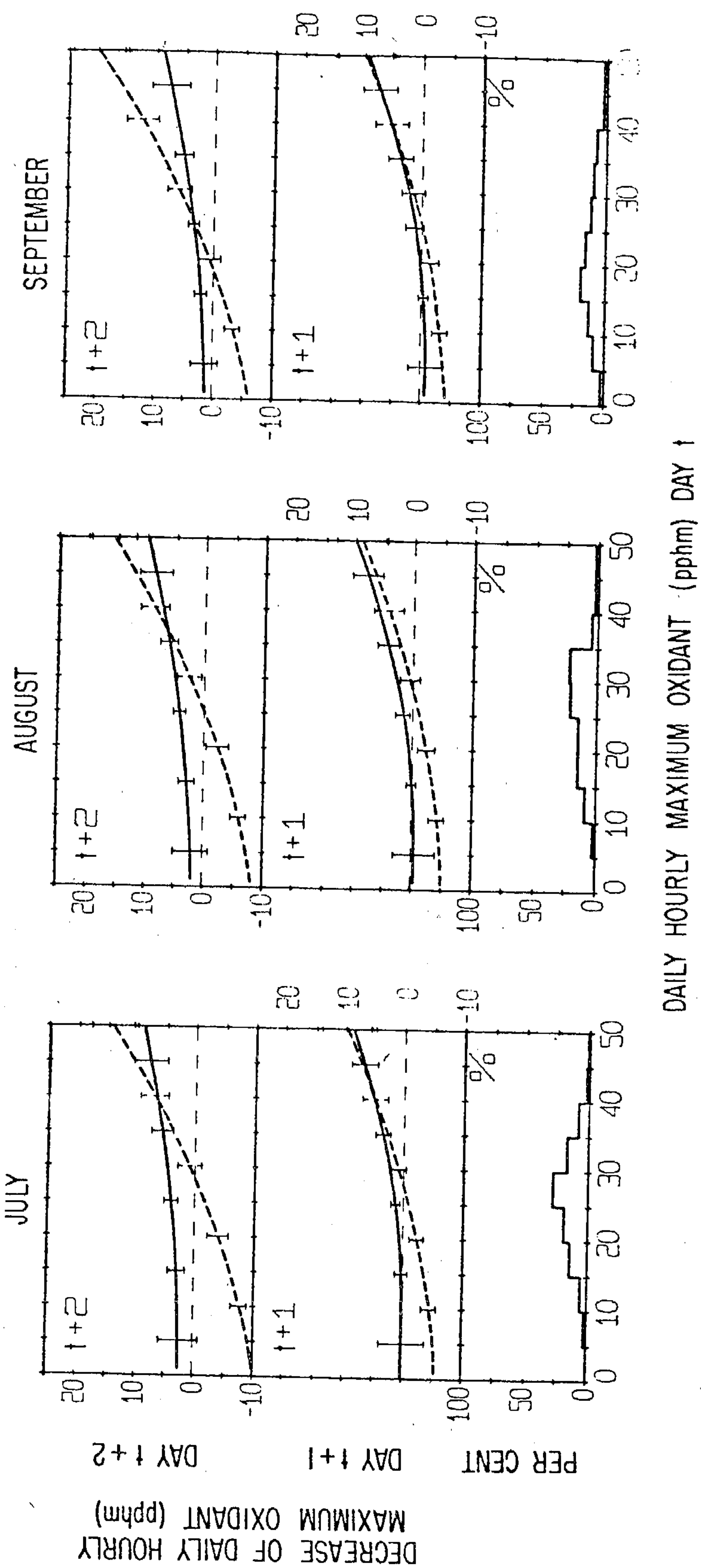

AZUZA
JULY
AUGUST
SEPTEMBER
t+2
t+1
%
DAY t+2
DAY t+1
PER CENT
DECREASE OF DAILY HOURLY MAXIMUM OXIDANT (pphm)
DAILY HOURLY MAXIMUM OXIDANT (pphm) DAY t

FIGURE 4

Average decreases in daily hourly maximum oxidant concentration for high smog months at Downtown Los Angeles.

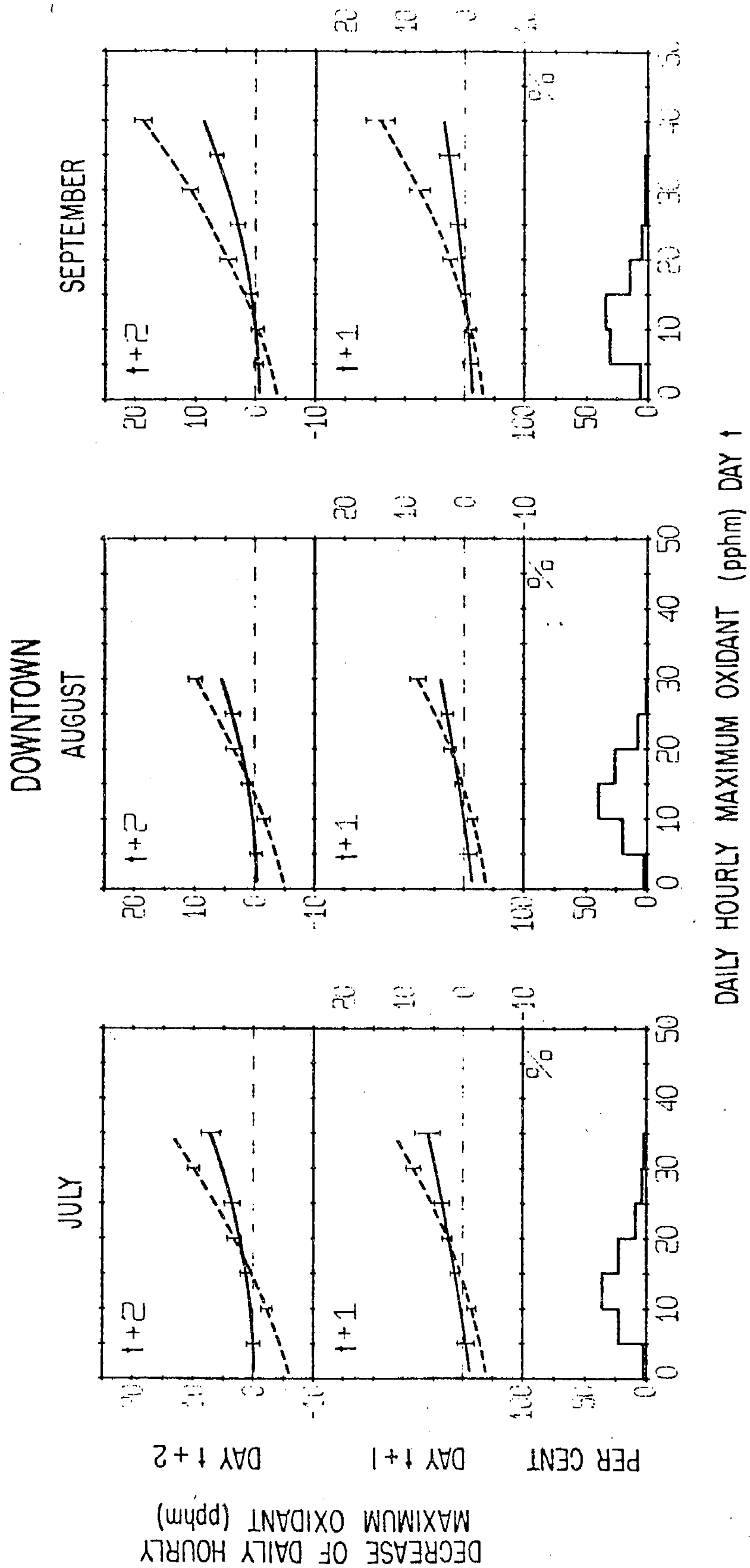

DOWNTOWN
JULY
AUGUST
SEPTEMBER
t+2
t+1
%
DAY t+2
DAY t+1
PER CENT
DECREASE OF DAILY HOURLY MAXIMUM OXIDANT (pphm)
DAILY HOURLY MAXIMUM OXIDANT (pphm) DAY t

FIGURE 5

Average decreases in daily hourly maximum oxidant concentration for high smog months at Lennox.

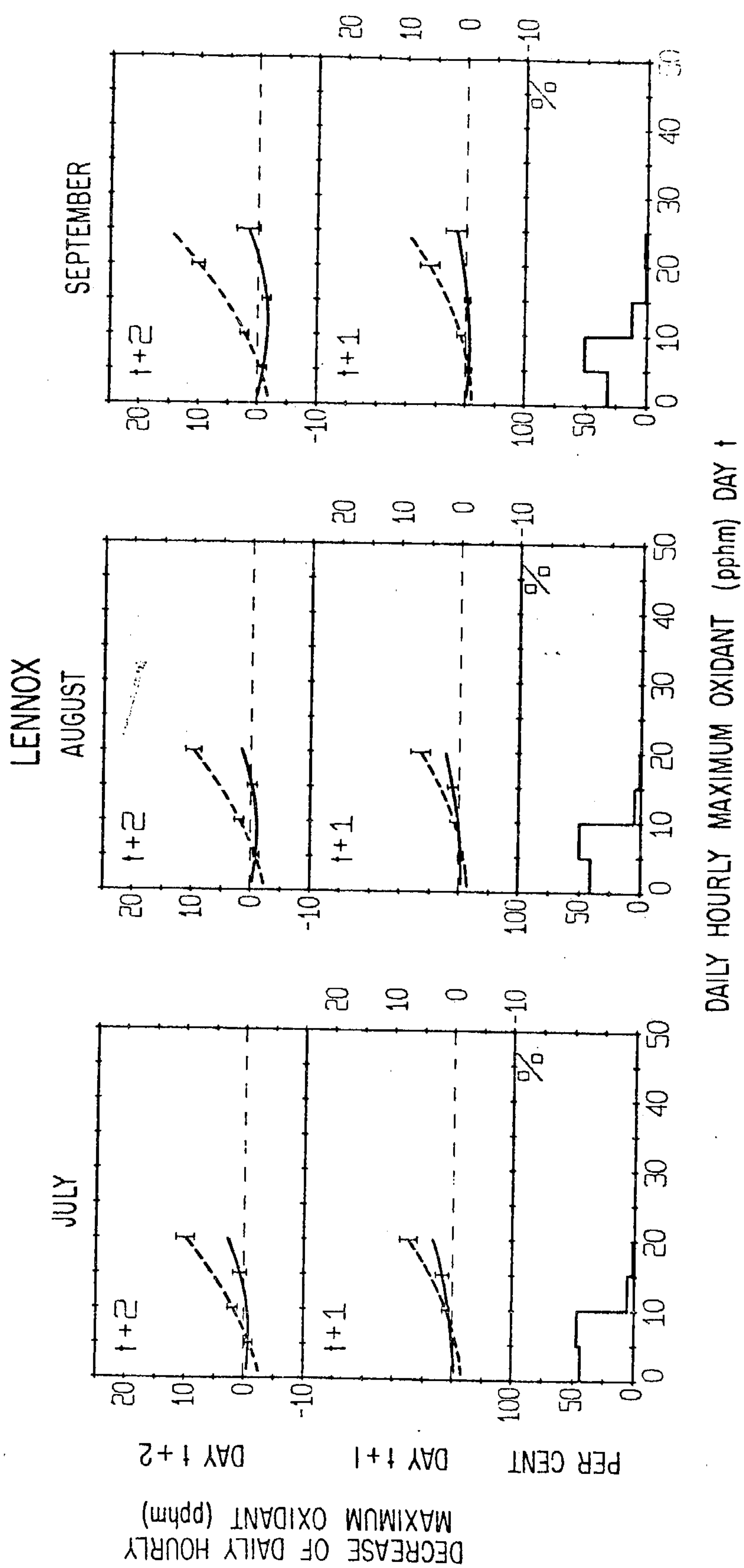
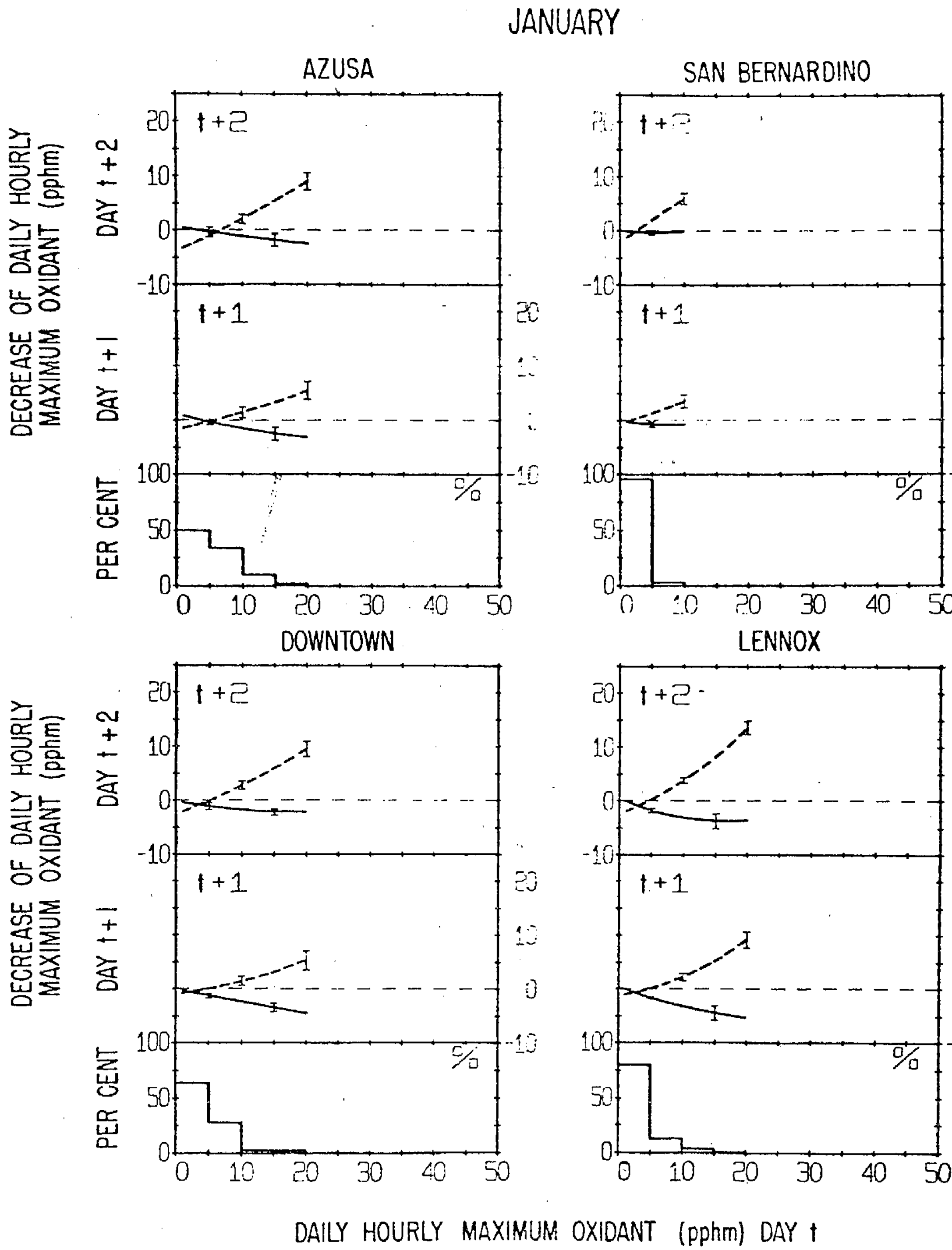

LENNOX
JULY
AUGUST
SEPTEMBER
t+2
t+1
%
DAILY HOURLY MAXIMUM OXIDANT (pphm) DAY t
DECREASE OF DAILY HOURLY MAXIMUM OXIDANT (pphm)
DAY t+2
DAY t+1
PER CENT

FIGURE 6

Average decreases in daily hourly maximum oxidant concentration for January at four stations: San Bernardino, Azusa, Downtown and Lennox.


JANUARY
AZUSA
SAN BERNARDINO
DOWNTOWN
LENNOX
t+2
t+1
DECREASE OF DAILY HOURLY MAXIMUM OXIDANT (pphm)
DAY t+2
DAY t+1
PER CENT
%
DAILY HOURLY MAXIMUM OXIDANT (pphm) DAY t

CHAPTER IV

REGRESSION ANALYSIS

INTRODUCTION

During the studies leading up to the results presented in the previous chapter we tested out a number of other statistical and pattern recognition approaches. While these other approaches are less successful than our final method in predicting weekend-weekday differences, the results are of interest in another light. In particular, our linear regression studies indicate which meteorological variables correlate best with oxidant level. These statistical correlations then provide clues to the underlying physical causal relationships which lead to the correlations.

The technique of stepwise linear regression is applied to our data base of meteorological variables to find models to predict oxidant maxima. Separate models are calculated for weekdays and weekends at each station to allow comparison of the predicted oxidant on weekends and weekdays of similar meteorology. We use the Statistical Package for the Social Sciences (SPSS) (1) for these regressions. Employing a number of input meteorological variables, this program finds the linear combination of predictor variables X_i which best forecasts oxidant levels,

$$Ox = a_0 + \sum_i a_i X_i + \varepsilon$$

where $a_0, a_1, \ldots$ are constants and ε an error term. The stepwise regression begins with one variable in the above equation, that which correlates most highly with the oxidant values to be predicted, and adds successive variables one at a time to improve the model. The SPSS program terminates when no further meaningful improvement in prediction is gained by the addition of another variable to the regression equation.

We include no pollutant data as input since this contains information about the day of the week, which would bias the models. Our models predict oxidant maxima using only meteorological variables which are for the most part independent of the day of the week. While the linear regression models are reasonably accurate at predicting oxidant at low levels, they consistently underestimate high oxidant concentrations and poorly differentiate between weekdays and weekends. In other words, the models calculated using weekdays and those using weekends are quite similar. While these models do not differentiate effectively between weekdays and weekends, the consistency with which certain meteorological variables are chosen as statistically important by stepwise regression provides some clues as to the meteorological and chemical processes involved in photochemical air pollution. We therefore report some of our regression results.

DATA BASE

In order to facilitate these computations, we have consolidated some of the air monitoring data and some of the meteorological data into one data file. This data file, which resides on a magnetic tape, contains data from 1972 and 1973 only since these are the years for which we have the most complete data set. Los Angeles County air monitoring data are obtained from the Los Angeles Air Pollution Control District (LAAPCD) for 1972 and from the California Air Resources Board (CARB) for 1973. Ground level meteorological data are obtained from the LAAPCD, except for the Riverside insolation data which are procured from the CARB. Upper air soundings at Los Angeles International Airport (LAX) are obtained from the National Weather Service. LAAPCD stations used are Downtown, Azusa, Burbank, West Los Angeles, Long Beach, Reseda, Pomona, Lennox, and Whittier. Meteorological data are available at Downtown, Burbank, Long Beach, Pomona, and LAX, and wind data at Downtown, Azusa, Burbank, Long Beach, Pomona and LAX. The upper air data are derived from two soundings daily at LAX. The data are arranged day by day, with all the data for day 1 preceding that for day 2, etc. Included with the data for any given day are the data for the previous day, so that the analysis using linear regression can access the data for two consecutive days at once. The total number of variables for each day is nearly 200, or nearly 400 if the data for the previous day are counted. The list of variables available for each day is included in Tables I and II.

A data management program is written so that any number of the variables listed can be selected and formed into a temporary work file which is stored on computer disk for use in the analyses. It is possible to add the square or the natural logarithm of any of the variables to the temporary work file. The user can also choose which year is desired (or to use both years), and whether data for weekdays, weekends, or the entire week are desired. Thus we have easy access to the entire data base without having to store it in the computer, which would be prohibitively costly.

RESULTS AND DISCUSSION

Two statistical measures of the validity of the models are calculated. The first is R^2, a standard statistical parameter for evaluation of linear regressions:

$$R^2 = \frac{\sum_i (\hat{y}_i - \bar{y})^2}{\sum_i (y_i - \bar{y})^2}$$

where y_i is an observed value of the quantity to be predicted, $\hat{y}_i$ a predicted value, and $\bar{y}$ the calculated mean of the variable. R^2 is a measure of the success of the regression equation in explaining variations in the data; it is the proportion of the total variation about the mean which is explained by the model. The second statistical parameter we use to indicate the accuracy of the models is

$$E = \frac{\sum_i |e_i|}{\sum_i y_i}$$

where $e_i = \hat{y}_i - y_i$, the error in a given prediction. E is the average fractional error in predictions of the model.

Both statistics indicate the limits of the models that we develop using the SPSS program. The R^2 values are low, always under 0.800 and often much lower. They point out a significant difference between coastal stations and inland stations since the values for the former are between 0.100 and 0.500 while the values for the latter are between 0.600 and 0.800. Perhaps the more useful statistic for our purposes is E, which is a measure of the success of a model as a predictor of oxidant maxima. These numbers are insensitive to location, and range between 0.23 and 0.40 fractional error in prediction. Input data are always from the same day as the oxidant value to be predicted. Models of this kind which ignore previous pollutant values seem to have little use for actual oxidant prediction when predictions are required a day in advance and the similar models which employ only data from the previous day to predict oxidant on a given day are less accurate. However, a study of the variables chosen for the regression equations can yield information about the relative importance of various meteorological variables in oxidant formation.

The initial regressions use only ground level meteorological variables as input, including wind speeds at various stations, several temperatures and humidities, and, at two locations, insolation. All runs use the full two years of data. The first runs use an input of 50 variables, including both the data for the same day as the oxidant to be predicted (T), and for the previous day (T-1). The results of these early runs are summarized in Table III for Lennox, a typical coastal station, Downtown Los Angeles, and Pomona, a typical inland station. Some of these variables are rarely or never selected by the stepwise regression and are therefore eliminated from consideration as predictors. Further runs with smaller input data sets select similar sets of predictors, with the data from the previous day adding no noticeable improvement to any of the models calculated. The data from a later set of runs are summarized in Table IV. The two strongest predictors in most runs are the temperature at Pomona and the insolation at Riverside. Sometimes these appear in the models as the square of the variable. SPSS predominately selects these as predictors even at coastal stations when the corresponding data from coastal locations are included as input. Other temperature and insolation values seem to have value as predictors as do humidity values at some locations. The wind speed data and the daily APCD predictions of several meteorological variables are rarely chosen as variables for the regression equations.

Another set of regressions uses as input data the natural logarithms of the various meteorological variables and the logarithms of the oxidant concentration, since the variables might be related by some multiplicative form instead of the additive form previously discussed. The results of these regressions are not significantly different than those without logarithms: the same variables are chosen as predictors for the models, and the accuracy is not significantly improved by use of a non-linear model. Some of these results are shown in Table V. In addition, as suggested by Bruntz et al. (2), we use ln(oxidant + 5) as the variable to be predicted by the regression program to reduce the distortion involved in taking the logarithm of small numbers and find no significant effect on the accuracy of the models generated.

Additional regression models are formulated with upper air data added to the data base. Also, a new variable is added to the data base, a calculated function whose value on a given day is the average of oxidant values for the 15 days before and the 15 days after the day in question, averaged over the four years 1970-1973. This introduces monthly mean oxidant as a predictor in such a way as to remove the day of the week variation which could bias the models. From a series of regressions using just these additional variables, the 750 mb temperature at 12:00 is chosen as the best predictor, especially at inland stations. The calculated monthly mean oxidant functions are also selected frequently. It seems that these functions replace insolation as predictors in the regression equation since they are similar to the insolation curves, and no insolation data are available to the program in these runs. These results are summarized in Table VI.

When some of the more frequently selected variables of the ground level set are added to the upper air data set, similar results are obtained. In all cases a temperature is selected as the best predictor. The Pomona temperature is selected at mid and coastal stations and the 750 mb temperature at 12:00 is chosen at inland stations. The calculated oxidant function is not selected as a good predictor when the insolation data are present in the data set. Instead, insolation at Riverside is selected in all runs. Some of these results are summarized in Table VII. The two most important predictors of oxidant maxima from our available set of meteorological variables are temperature at Pomona, or at 750 mb at 12:00 at LAX, and insolation at Riverside. Humidity values and the smoothed oxidant function are added subsequently by the program to improve the models. While it is not surprising that temperature and insolation are the best predictors of oxidant maxima, it is interesting to note that the best predictors for a given oxidant maximum is not necessarily a meteorological variable from a nearby location. For example, temperature at Pomona is the best predictor for oxidant at Downtown Los Angeles and Lennox, but not at Pomona, where the 750 mb temperature at 12:00 at LAX is selected first.

The insensitivity of the linear regression models to weekdays and weekends is easily illustrated by a series of runs that we did accidentally. The data set for these runs was constructed to include all the data day by day, instead of being sorted into weekdays and weekends. The models calculated using this complete set of all days are nearly indistinguishable from those calculated using just weekdays or just the weekends. The variables chosen as the best predictors are the same, the constants are similar and the accuracy of the models is not significantly different from the weekday and weekend models, though they are slightly more accurate due to the fact that the data set is larger when all the days are used.

In summary, the meteorological variables found to correlate best with oxidant level are temperature and insolation. Relative humidity and seasonal mean oxidant level contain a smaller amount of additional information. In spite of the general assumption to the contrary, inversion height and wind speed are not found to be useful.

REFERENCES

1. Nie, N., Bent, D. H., Hull, C. H., Statistical Package for the Social Sciences, McGraw-Hill, New York, 1970.

2. Bruntz, S. M., et al., Preprint Volume, Symposium on Atmospheric Diffusion and Air Pollution, Santa Barbara, CA., 1974.

Table I. Variables in the Data Base, Each Available for Every Day of the Years 1972-1973

Day of the year

Day of the week

For each of the nine LAAPCD stations, for both oxidant and CO:
- 24 hour average
- Maximum hourly value
- Hour of maximum
- Maximum 4 hour average (8 hour average for CO)
- Beginning hour of 4 (8) hour average
- Instantaneous maximum
- Hour of instantaneous maximum

Wind speed at each of the six stations, average for 9:00-14:00

For each of the five LAAPCD meteorological stations:
- Temperature, average for 9:00-14:00
- Relative humidity, average for 9:00-14:00

Insolation, average for 9:00-14:00, at
- Downtown
- LAX
- Riverside

Average 6:00-12:00 wind at Downtown

Inversion height at LAX

LAAPCD predictions of maximum oxidant and CO values at 10 LAAPCD stations

LAAPCD predictions of meteorological variables:
- Inversion height
- Mixing depth
- Average wind 6:00-12:00 at Downtown

Data from LAX soundings, twice daily, 6:00 and 12:00
- 750 mb height
- 750 mb temperature
- 850 mb height
- 850 mb temperature

Table II. Variables in the Data Base

Station	Oxidant[a]	CO[a]	Wind[b]	Temp[b]	Humidity[b]	Insol.[b]	Inv. Ht.	Upper Air[c]	Oxidant[d]	CO[d]	Inv. Ht.[d]	Mixing Height[d]
Downtown	X	X	X	X	X	X			X	X		
Azusa	X	X	X						X	X		
Burbank	X	X	X	X	X				X	X		
West LA	X	X							X	X		
Long Beach	X	X	X	X	X				X	X		
Reseda	X	X							X	X		
Pomona	X	X	X	X	X				X	X		
Lennox	X	X							X	X		
Whittier	X	X							X	X		
LAX			X	X	X	X	X	X			X	X
Riverside						X						

[a] 24 hour average
Maximum hourly value
Hour of maximum
Maximum 4 hour average (8 hour for CO)
Beginning hour of 4 (8) hour average
Instantaneous maximum
Hour of instantaneous maximum

[b] 9:00-14:00 average

[c] For each of two soundings, 6:00 and 12:00
750 mb height
750 mb temperature
850 mb height
850 mb temperature

[d] LAAPCD predictions

Table III. Results of Initial Linear Regressions with 50 Variables

Variables	Oxidant Maximum Downtown		Oxidant Maximum Lennox		Oxidant Maximum Pomona	
	Weekdays	Weekends	Weekdays	Weekends	Weekdays	Weekends
T[a]						
Day of year						
(Day of year)^2						
Wind-Azusa						
(Wind-Azusa)^2						
Wind-Long Beach		6	4	6		4
(Wind-Long Beach)^2						
Humidity-LAX						
(Humidity-LAX)^2			8			2
Humidity-Pomona					4	
(Humidity-Pomona)^2	7	8				
Temperature-LAX	6					5
(Temperature-LAX)^2		4			2	
Temperature-Pomona				1	1	
(Temperature-Pomona)^2	1	1				1
Temperature-Downtown						
(Temperature-Downtown)^2	5		1			
Insolation-LAX	8	7	6		8	
(Insolation-LAX)^2						
Inversion height-LAX						
(Inversion height-LAX)^2						
Wind-Downtown	3	3			5	
(Wind-Downtown)^2						
Insolation-Riverside					3	3
(Insolation-Riverside)^2	4	2	3			
LAAPCD prediction of inversion base					6	
LAAPCD prediction of inversion temperature		5				8

Table III. Continued

Variables	Downtown Weekdays	Downtown Weekends	Lennox Weekdays	Lennox Weekends	Pomona Weekdays	Pomona Weekends
T-1[b]						
Wind-Azusa				5		
(Wind-Azusa)^2					7	
Wind-Long Beach						
(Wind-Long Beach)^2						
Humidity-LAX						
(Humidity-LAX)^2				8		
Humidity-Pomona			5			6
(Humidity-Pomona)^2						
Temperature-LAX	2					
(Temperature-LAX)^2			2			
Temperature-Pomona						
(Temperature-Pomona)^2				4		
Temperature-Downtown						
(Temperature-Downtown)^2						
Insolation-LAX						
(Insolation-LAX)^2						
Inversion height-LAX						
(Inversion height-LAX)^2						
Wind-Downtown				3		
(Wind Downtown)^2			7			
Insolation-Riverside						7
(Insolation-Riverside)^2				7		
LAAPCD prediction of inversion base						
LAAPCD prediction of inversion temperature				2		
R^2	.694	.652	.297	.372	.692	.707
E	.303	.287	.367	.355	.298	.274

[a]Variables for the same day as oxidant value to be predicted.

[b]Variables for day previous to oxidant value to be predicted.

Table IV. Results of Linear Regressions using Limited Set of Ground Level Meteorological Data

Variables	Oxidant Maximum Downtown		Oxidant Maximum Lennox		Oxidant Maximum Pomona	
	Weekdays	Weekends	Weekdays	Weekends	Weekdays	Weekends
T[a]						
Wind-Long Beach		5	4		4	5
Humidity-Pomona					6	3
(Humidity-Pomona)^2	5	6				
Humidity-Downtown					2	
(Humidity-Downtown)^2						6
Temperature-Pomona				1	1	
(Temperature-Pomona)^2	1	1				1
Temperature-Downtown						
(Temperature-Downtown)^2			1			
Insolation-LAX			6			
(Insolation-LAX)^2				4		
Inversion height-LAX	6	4		3	5	4
Wind-Downtown	3	3				
Insolation-Riverside					3	2
(Insolation-Riverside)^2	2	2	3	6		
T-1[b]						
Humidity-Pomona			5	5		
(Humidity-Pomona)^2						
Temperature-Pomona	4					
(Temperature-Pomona)^2			2	2		
R^2	.663	.625	.263	.267	.658	.680
E	.311	.344	.377	.386	.318	.288

[a]Variables for the same day as oxidant value to be predicted.

[b]Variables for day previous to oxidant value to be predicted.

Table V. Results of Linear Regressions using Logarithms of the Input Variables and Oxidant Values[a]

Variables	Oxidant Maximum Downtown		Oxidant Maximum Lennox		Oxidant Maximum Pomona	
	Weekdays	Weekends	Weekdays	Weekends	Weekdays	Weekends
T						
Wind-Azusa						
Wind-Long Beach						
Humidity-LAX						3
Humidity-Pomona					3	
Humidity-Downtown						
Temperature-LAX						
Temperature-Pomona	1	1			1	1
Temperature-Downtown						
Insolation-LAX	5	5				
Inversion height-LAX		6				4
Wind-Downtown	3	3			4	6
Insolation-Riverside	2	2			2	2
LAAPCD prediction of inversion height					5	
LAAPCD prediction of inversion temperature		4				5
T-1[b]						
Humidity-LAX	4					
Insolation-Riverside	6				6	
R^2	.732	.714			.780	.787
E	.271	.264			.277	.260

[a]Much more data from the previous day was used, but not chosen for any of the regression models.

[b]Variables for the same day as oxidant value to be predicted.

[c]Variables for day previous to oxidant value to be predicted.

Table VI. Results of Regressions Using Only Upper Air Data and Calculated Oxidant Function

Variables	Oxidant Maximum Downtown		Oxidant Maximum Lennox		Oxidant Maximum Pomona	
	Weekdays	Weekends	Weekdays	Weekends	Weekdays	Weekends
T[a]						
750 mb height at 6:00						
750 mb temperature at 6:00						
850 mb height at 6:00						4
850 mb temperature at 6:00	3					
750 mb height at 12:00	4	3		4		
750 mb temperature at 12:00	1	1	1	2	1	1
850 mb height at 12:00			3	1		
850 mb temperature at 12:00		4	2	4	3	3
Oxidant function Maximum-Azusa				3		
Oxidant function Average-Burbank						
Oxidant function Maximum-Pomona			4			
Oxidant function Average-Downtown	2	2			2	2
R^2	.507	.472	.162	.160	.657	.618
E	.364	.356	.387	.400	.317	.323

[a]Variables for the same day as oxidant to be predicted.

Table VII. Results of Regressions Using Both Ground Level and Upper Air Meteorological Variables

Variables	Oxidant Maximum Downtown		Oxidant Maximum Lennox		Oxidant Maximum Pomona	
	Weekdays	Weekends	Weekdays	Weekends	Weekdays	Weekends
T[a]						
Insolation-Riverside						
$(\text{Insolation-Riverside})^2$	2	2	3	3	2	2
Temperature-Pomona				1		
$(\text{Temperature-Pomona})^2$	1	1	1		4	3
Humidity-Pomona		5			5	4
$(\text{Humidity-Pomona})^2$	4		5			
750 mb height at 6:00	6					
750 mb temperature at 6:00		3				
850 mb height at 6:00						5
850 mb tempearture at 6:00		6			6	
750 mb height at 12:00	5		6			6
750 mb temperature at 12:00					1	1
850 mb height at 12:00						
850 mb temperature at 12:00				5		
Oxidant function Maximum-Azusa	3	4	2	2		
Oxidant function Average-Burbank					3	
Oxidant function Maximum-Pomona						
Oxidant function Average-Downtown						
$(\text{Temperature-Long Beach})^2$			4			
Humidity-LAX				4		
$(\text{Humidity-Long Beach})^2$				6		
R^2	.636	.587	.263	.314	.680	.677
E	.327	.312	.369	.363	.304	.288

[a]Variables for the same day as oxidant value to be predicted.

CHAPTER V

CHEMICAL AND METEOROLOGICAL DATA BASE

INTRODUCTION

The analyses presented of the chemical and physical behavior of the South Coast Air Basin are based on a very extensive set of atmospheric measurements. We have collected on magnetic computer tapes a fairly complete set of air quality and meteorological data for the South Coast Air Basin and some data for other areas of the state. This chapter describes the data. First are lists of the various tapes, the variables measured, and the locations at which data are recorded. Following that is a tape by tape list of the specific data available at each station and for what time periods.

CHEMICAL DATA

Data from the California Air Resources Board (CARB)

We have data for 1963-1973 with each year on a separate tape. Data are arranged by pollutant. Within each pollutant, the data are arranged by county for all counties except Los Angeles for which data are available in this format only since 1973. The 24 hourly averages, daily average, daily hourly maximum, and instantaneous maximum are all available for each day. Measurements are recorded for oxidant, CO, NO, NO_2, NO_x, SO_2, and hydrocarbons. The Los Angeles data set is fairly complete but it is often the case that other stations will not measure all of these pollutants and in some instances only oxidant data are available. Few stations span the entire 11 years:

many stations have begun data collection during this period, several have been moved and many have been discontinued. The stations on these tapes are listed in Table II and the data are detailed in Tables VI-XVI.

Data from the Los Angeles Air Pollution Control District (LAAPCD)

We have data for the LAAPCD stations for the period 1955-1972. The data for 1973 are on the CARB tapes. These data are all on five tapes, grouped by pollutant, and within each pollutant the data are arranged chronologically for each station. The LAAPCD stations record the same data as the CARB stations with the addition of a separate measurement of methane concentration. Most stations record all of the pollutants. As with the data on the CARB tapes, only a few of the stations span the entire period. The stations on these tapes are listed in Table IV, and the data are listed in Tables XVII-XXII.

METEOROLOGICAL DATA

Data from the Los Angeles Air Pollution Control District

Some meteorological data are available on the same tapes as the air monitoring data. These include hourly measurements at several weather stations of temperature, relative humidity, and insolation. The daily maximum is also recorded. There is a separate tape with this data for 1973. In addition, for 1955-1973, we have three tapes with hourly measurements of wind speed and wind direction at many stations throughout the county. For these data an "hour" begins on the half hour: the number recorded for "12" is the average between 11:30-12:30 instead of 12:00-1:00 as with all the other data. The stations on these tapes are listed in Table V and the data are detailed in Tables XXIII-XXV.

Data from the National Weather Service

We have upper air data for 1972 and 1973 only, on one tape. Soundings are twice daily at El Monte, Los Angeles International Airport and Vandenberg Air Force Base. The El Monte data is for weekdays only, and the 1972 Vandenberg data has 15% of the data missing. These data include measurements of pressure, temperature, relative humidity, wind speed and wind direction at various heights, and are described in Table XXVI.

Miscellaneous

In addition to the data on tapes, we have some meteorological data on computer cards. These data are for the years 1972 and 1973 only, and include:

1. Hourly readings of insolation at Riverside.
2. Inversion height, one measurement per day, at Downtown.
3. APCD daily predictions of oxidant maxima, CO maxima, inversion height, mixing height, and morning wind speed. These predictions are made each day at 10 AM for the following day.

Table I. List of Tapes

From California Air Resources Board (CARB):

Each tape contains all the data for one year

CARB63
CARB64
CARB65
CARB66
CARB67
CARB68
CARB69
CARB70
CARB71
CARB72
CARB73

From the Los Angeles Air Pollution Control District (LAAPCD):

LAT059	Contains the data previous to 1959
LA6064	Contains the data for 1960-1964
LA6569	Contains the data for 1965-1969
LA7071	Contains the data for 1970-1971
LA72	Contains the data for 1972
LAMET	Contains variables 74, 76, and 78 for 1972-1973
WINDONE	Contains wind data for stations 2-71 for 1955-1970
WINDTWO	Contains wind data for stations 71-119 for 1955-1970
WINDTHREE	Contains wind data for all stations for 1971-1973

From the National Weather Service (NWS):

UPPERAIR	Contains soundings for 1972-1973

Table II. Variables Recorded

08	Particulates (ARB)
11	(Hydrocarbons-Methane) (APCD)
12	Oxidant
14	$10(NO_x)/(Hydrocarbons-CH_4)$(APCD)
15	CO
18	SO_2
21	NO_2
23	NO
29	NO_x
31	Hydrocarbons
32	Methane (APCD)
33	Ozone by rubber cracking (APCD)
60	Particulates (APCD)
74	Temperature (APCD)
76	Relative Humidity (APCD)
78	Insolation (APCD)
80	Visibility (APCD)
90	Eye Irritation (APCD)

Table III. Stations on CARB Tapes, in Alphabetical Order with Station Numbers

Station Number	Location
02 60330	Alameda
02 60329	Albany
06 80117	Alpine
05 36167	Alta Loma
07 25761	Alturas
05 30176	Anaheim
08 45554	Anderson
01 12502	Arcata
01 12504	Arcata-Fire Stn
12 31802	Auburn
09 16702	Avenal
05 70060	Azusa
11 33133	Banning
11 33150	Banning-Allesandro
11 36155	Barstow
11 33127	Beaumont
02 48876	Benicia
02 60326	Berkeley
05 36177	Big Bear City-Moonridge
05 36184	Big Bear Lake
10 14691	Bishop
09 15201	Bkrsfld ARB-Golden
09 15202	Bkrsfld H. D. -Flower St
09 15203	Bkrsfld-Chester St
08 04623	Blavo
01 12507	Blue Lake
11 33132	Blythe
01 2375	Bounville
11 15209	Boron-Fire Stn
11 13683	Brawley-Fire Stn
10 26771	Bridgeport
10 26773	Bridgeport-Co. Maint Yd
05 70069	Burbank
02 41544	Burlingame
02 41545	Burlingame-Burlingame Ave
02 41546	Burlingame-Sewage Plant
08 45556	Burney

Table III. Continued

Station Number	Location
11 13681	Calexico-Fire Stn
01 23752	Calpilla
05 56416	Camarillo-Elm Dr
05 56407	Camarillo-Magnolia
05 56408	Camarillo-Palm
12 09663	Camino
06 80102	Carlsbad
03 27534	Carmel
03 27539	Carmel Valley
05 42359	Carpinteria
08 04621	Chico
11 15211	China Lake
05 36173	Chino-Riverside Ave
05 36162	Chino Airport
06 80103	Chollas Heights
06 80114	Chula Vista
06 80112	Chula Vista H. D.
01 49886	Cloverdale
09 10231	Coalinga
09 39253	Colonial Heights
12 55921	Columbia
08 06641	Colusa
02 07435	Concord-Bishop Dr
02 07436	Concord-Treat Blvd
09 16704	Corcoran-Fire Stn
05 33128	Corona
05 30185	Costa Mesa-Harbor
05 30182	Costa Mesa-MBL No. 4
01 08651	Crescent City
05 36172	Crestline
02 07437	Crockett-Kendall Ave
05 36161	Cucamonga UCR Lemon *2
08 57567	Davis
08 57568	Davis-5th St
06 80109	Del Mar
09 15210	Delano
12 46851	Downieville
08 57571	Dunningan-Main St

Table III. Continued

Station Number	Location
06 80104	El Cajon
11 13684	El Centro APCD
11 13682	El Centro-Broadway
05 70579	El Monte
05 70051	El Segundo
05 30186	El Toro
05 33152	Elsinore
06 80105	Escondido-So. Grape
06 80111	Escondido-Valley Blvd
06 80115	Escondido-Valley Pkwy
01 12501	Eureka
01 12503	Eureka H. D. -6th and I St
01 12513	Eureka-Fort Humboldt
01 12505	Eureka-General Hospital
01 12506	Eureka-Highway Dept
02 48872	Fairfield
02 48875	Fairfield-BAAPCD
05 56406	Fillmore
09 10229	Five Points
05 36154	Fontana
05 36174	Fontana-Cypress
05 36176	Fontana-Foothill
01 23756	Fort Bragg-Central
01 23755	Fort Bragg-Firestone
01 23760	Fort Bragg-So. Main
01 12508	Fortuna
02 60336	Fremont-Chapel Way
02 60333	Fremont-Union St
09 10232	Fresno-Calif. State
09 10226	Fresno-Cedar St
09 10227	Fresno-Courthouse Lobby
09 10228	Fresno-Courthouse 8th Flr
09 10233	Fresno-Herndon
09 10234	Fresno-Olive
01 12511	Garberville
12 09666	Georgetown
02 43385	Gilroy-Monterey St
05 42363	Goleta
03 27537	Gonzales-High School

Table III. Continued

Station Number	Location
09 54564	Goshen
05 30183	Green River Golf Course
09 16701	Hanford H. D.
09 16703	Hanford-Courthouse
02 60337	Hayward-La Mesa
01 49885	Healdsburg
05 33130	Hemet
05 33141	Hemet-State St
03 35821	Hollister
05 70073	Hollywood Freeway
01 12516	Hoopa
05 30178	Huntington Beach
06 80126	Imperial Beach
11 33129	Indio
11 33145	Indio-ARB
11 33139	Indio-Oasis St
05 70068	Inglewood
06 80118	Jacumba
06 80116	Kearney Mesa
13 17712	Kelseyville
02 21452	Kentfield
09 15205	Kern Refuge
03 27535	King City
12 31805	Kings Beach
05 30177	La Habra
05 30189	Laguna Beach-Broadway
05 36181	Lake Gregory
13 17711	Lakeport
13 17713	Lakeport-Lakeport Blvd
11 70082	Lancaster
10 26772	Lee Vining
05 70076	Lennox
12 31807	Lincoln
06 80119	Lindbergh Field-Wthr only
08 51892	Live Oak-Fire Stn
02 60335	Livermore-Railroad
02 60331	Livermore-Rincon

Table III. Continued

Station Number	Location
09 39255	Lodi
02 43378	Loma Prieta
04 42360	Lompoc
04 42353	Lompoc H. D.
10 14692	Lone Pine-Airport
10 14693	Lone Pine-Co. Maint Yd
05 70072	Long Beach
12 31806	Loomis Basin
05 30184	Los Alamitos Air Station
05 30190	Los Alamitos-Orangewood
05 70001	Los Angeles-Downtown
05 70581	Los Angeles-Mt. Lee
05 70070	Los Angeles-USC Med Ctr
09 24522	Los Banos
02 43380	Los Gatos
12 03612	Lower Kirkwood
11 36186	Lucerne Valley
12 09665	Luther Pass
05 70084	Lynwood
09 20001	Madera H. D.
09 20002	Madera-Library
08 04624	Manzanita
08 04625	Manzanita-99E
12 22741	Mariposa
02 07427	Martinez
02 07434	Martinez-Jones St
08 58931	Marysville
07 47867	McCloud
01 12509	McKinleyville
09 24521	Merced
09 24523	Merced-Trailer
09 24524	Merced-18th St
05 33135	Mira Loma
06 80106	Mission Beach
06 80108	Mission Valley
09 50556	Modesto
09 50557	Modesto-J St
09 50558	Modesto-Oakdale Rd
11 15207	Mojave
03 27538	Monterey APCD
03 27532	Monterey Peninsula Col

Table III. Continued

Station Number	Location
05 56411	Moorpark College
04 40833	Morro Bay
02 43387	Mountain View-Cuesta
02 43381	Mountainview
07 47866	Mt. Shasta
02 28781	Napa-First St
02 28783	Napa-Jefferson St
02 28782	Napa-St Helena Hwy
06 80124	National City
11 13680	Naval Air Facility
11 36169	Needles High School
06 80107	Nestor
09 39259	New Jerusalem
05 70081	Newhall
05 30180	Newport Beach
05 33140	Norco-Prado Park
08 04622	Nord
01 12515	North Arcata
02 07431	North Richmond
01 23757	North Ukiah-Kuki Rd
02 60327	Oakland
02 60334	Oakland-Jackson
02 60338	Oakland-Mtn Blvd
06 80110	Oceanside
06 80121	Oceanside-So Cleveland
05 56402	Ojai
05 36171	Ontario Airport
05 36152	Ontario-Chaffey High Sch
05 30178	Orange County Airport
01 12512	Orick
08 04625	Oroville-Bird St
05 56485	Oxnard
05 56410	Oxnard-A St
11 33131	Palm Springs
11 33143	Palm Springs-Amado
11 33137	Palm Springs-Fire Stn
09 10230	Parlier
05 70079	Pasadena
05 70064	Pasadena-Villa St

Table III. Continued

Station Number	Location
05 70083	Pasadena-Walnut
04 40832	Paso Robles
09 50560	Patterson
05 33149	Perris
02 49882	Petaluma
02 49883	Petaluma-Payran
02 07430	Pittsburg
12 09664	Placerville
08 51893	Pleasant Grove
02 60332	Pleasanton
01 23758	Point Arena
05 56409	Point Mugu
02 07432	Point Richmond
12 09661	Pollack Pines
05 70075	Pomona
02 07429	Port Chicago
05 56412	Port Hueneme
09 54563	Porterville
12 32811	Quincy
12 32812	Quincy-Hospital
08 52901	Red Bluff
08 52903	Red Bluff-AG Comm Office
08 52906	Red Bluff-Lincoln
08 52902	Red Bluff-Radar Base
08 45551	Redding H. D.
08 45552	Redding-Courthouse
08 45555	Redding-H. D. Roof
08 45553	Redding-Market
05 36165	Redlands
05 70078	Redondo Beach
02 41541	Redwood City
05 70074	Reseda
05 36166	Rialto Airport
02 07428	Richmond
02 07433	Richmond-13th St
11 15206	Ridgecrest
02 48877	Rio Vista-Main St
05 33148	Riverside ARB-UCR Ox Sate
05 33146	Riverside-Magnolia

Table III. Continued

Station Number	Location
05 33144	Riverside-Rubidoux
05 33142	Riverside-Trailer
05 33134	Riverside-UCR Animal Fac
05 33147	Riverside-UCR Wthr Shack
05 33126	Riverside-11th St Mall
12 31801	Roseville
12 31804	Roseville-So Curbey
08 34277	Sacto H. D. -Stockton Blvd
08 34278	Sacto-Creekside School
08 34281	Sacto-10th and P St
08 34282	Sacto-1025 P St
08 34276	Sacto-13th and J St
08 34280	Sacto-7th and I St
09 50559	Salida
03 27531	Salinas H. D. -Natividad Rd
03 27536	Salinas-Alisal
01 12510	Samoa
01 12517	Samoa-Store
01 12514	Samoa-Vance Ave
05 36151	San Bernardino
06 80120	San Diego-Island Ave
06 80125	San Diego-North Park
06 80123	San Diego-Overland
06 80101	San Diego-8th and E St
02 90303	San Francisco-Ellis St
02 90302	San Francisco-Mission St
02 90301	San Francisco-Union Sq
02 90304	San Francisco-23rd St
02 43383	San Jose-Humboldt
02 43377	San Jose-Moorpark
02 43386	San Jose-Piedmont Rd
02 43379	San Jose-West Alma Ave
02 43382	San Jose-4th St
02 43376	San Jose-5th St
03 35822	San Juan Bautista
05 30188	San Juan Capistrano
02 60328	San Leandro
04 40831	San Luis Obispo
02 41543	San Mateo Bridge
06 80113	San Onofre
02 21451	San Rafael

Table III. Continued

Station Number	Location
06 80122	San Ysidro
05 30181	Santa Ana Canyon
05 30187	Santa Ana-Police Stn
05 30191	Santa Ana-Weir Canyon Rd
05 42358	Santa Barbara-Satelite
05 42354	Santa Barbara ARB
05 42351	Santa Barbara H. D.
05 42355	Santa Barbara-State St
03 44841	Santa Cruz
04 42352	Santa Maria ARB
04 42356	Santa Maria-Library
04 42357	Santa Maria-Wtr Storage
05 56404	Santa Paula
02 49881	Santa Rosa
02 49884	Santa Rosa-Humboldt St
04 42361	Santa Ynez
09 15208	Shafter-City Hall
05 56413	Simi Valley
05 36179	Sky Forest
08 58933	Smartville
12 09667	So Lake Tahoe Airport
12 09662	So Lake Tahoe-Police Dept
12 09668	So Lake Tahoe
02 49887	Sonoma-1st St
12 55922	Sonora
12 55924	Sonora-Forrest Rd
09 39251	Stockton-So. American
09 39256	Stockton-So. Fresno
09 39252	Stockton-Hazelton St
09 39257	Stockton-Hotel
02 43384	Sunnyvale
07 18721	Susanville
08 51894	Sutter City
09 15204	Taft
09 15212	Taft-Cedar St
12 31803	Tahoe City
05 33151	Temecula
05 70580	Temple City
11 33138	Thermal
05 56403	Thousand Oaks
05 56415	Thousand Oaks-Windsor

Table III. Continued

Station Number	Location
09 54562	Three Rivers
09 39254	Tracy
09 39258	Tracy-Caltrans
01 12518	Trinidad
12 29791	Truckee-Airport
07 47862	Tulelake
07 47863	Tulelake-Fairground
12 55923	Tuolumne City
09 50561	Turlock
11 36178	Twentynine Palms-Utah Tr
01 23751	Ukiah
01 23761	Ukiah-Ct House
01 23762	Ukiah-Firehouse
01 23754	Ukiah-Mendo Mill
05 36174	Upland-Civic Center
05 36175	Upland ARB
05 36164	Upland Orange #1 UCR
05 36160	Upland UCR Lemon #1
05 36153	Upland-Justice Ct
11 33136	Upper Coachella Valley
12 03611	Upper Kirkwood
02 48878	Vacaville
02 48871	Vallejo H. D. -Broadway
02 48873	Vallejo TLR-Tuolumne
02 48874	Vallejo-BAAPCD
02 48879	Vallejo-304 Toulumne
05 56401	Ventura
05 56414	Ventura-Telegraph Rd
11 36168	Victorville
09 54561	Visalia-Old Jail
02 07426	Walnut Creek
08 34279	Walnut Grove
03 44842	Watsonville-Hospital
03 44844	Watsonville-PG &E
03 44843	Watsonville-Trailer
01 53911	Weaverville
01 53912	Weaverville-Hosp
07 47865	Weed

Table III. Continued

Station Number	Location
05 70071	West Los Angeles
08 57570	West Sacramento-15th St
05 70576	Westwood
08 58932	Wheatland
05 70080	Whittier
01 23753	Willits
08 57566	Woodland
08 57569	Woodland-W. Main St
07 47861	Yreka
07 47864	Yreka-Courthouse
08 51891	Yuba City

Table IV. Stations on LAAPCD Air Quality Tapes

Station Number	Location
1	Downtown
9	Burbank
13	Los Angeles International Airport
20	Hermosa Beach
21	Long Beach Airport
39	LA - Federal Building
41	Lockheed Airport
51	El Segundo
55	East Long Beach
60	Azusa
61	Ontario Airport
64	Pasadena
67	Downey
68	Inglewood
69	Burbank
70	USC Medical Center
71	West Los Angeles
72	Long Beach
73	Hollywood Freeway
74	Reseda
75	Pomona
76	Lennox
78	Redondo Beach
79	Pasadena
80	Whittier
81	Newhall
82	Antelope Valley
83	Pasadena
89	Palmdale Airport

Table V. Stations on LAAPCD Wind Tapes

Station Number	Location
2 W	Zuma Beach
8 W	San Pedro
12 W	Redondo Beach
13 W	Los Angeles International Airport
14 W	Venice
17 W	Santa Monica
21 W	Long Beach Airport
22 W	Downey
27 W	Hollywood
34 W	Vernon
41 W	Lockheed Airport
61 W	Ontario Airport
63 W	Newport Beach
67 W	Canoga Park
71 W	Anaheim AMS
75 W	APCD Hqtrs AMS
81 W	Rivera
86 W	Encino
89 W	Palmdale Airport
94 W	Brackett Airport
95 W	Buena Park
97 W	Azusa AMS
98 W	Lancaster
99 W	La Habra AMS
100 W	Burbank AMS

Table V. Continued

Station Number	Location
101W	Long Beach AMS
102W	West L. A. AMS
103W	L. A. City College
104W	Malibu
106W	Walnut
107W	Reseda AMS
108W	La Canada
109W	Pomona AMS
112W	Compton
113W	Mission Hills
114W	Whittier AMS
115W	Newhall AMS
117W	Lancaster AMS
118W	Lennox AMS
119W	Alhambra
120W	Hawthorne
121W	Saugus
122W	Pasadena AMS
123W	Marina Del Rey
124W	Mount Wilson
125W	Catalina
126W	Costa Mesa AMS
127W	Los Alamitos AMS

Table VI. Data on CARB63, Number of Days with Data per Station per Variable

Station	Variables							
	8	12	15	18	21	23	29	31
101	365	365	365	0	365	365	365	0
104	120	0	0	0	0	0	0	0
126	0	365	365	0	184	0	0	0
127	0	214	0	0	0	0	0	0
128	0	214	0	0	0	0	0	0
151	365	365	365	0	365	365	365	0
152	0	92	30	61	92	92	0	0
153	0	92	0	92	92	92	0	0
176	0	365	365	365	365	365	365	0
201	306	365	122	306	306	306	306	0
202	365	0	0	0	0	0	0	0
226	275	365	122	0	365	365	365	0
227	365	0	0	0	0	0	0	0
251	151	364	0	0	30	30	30	0
252	214	61	214	0	31	31	31	0
253	365	0	0	0	0	0	0	0
254	365	0	0	0	0	0	0	0
255	334	0	0	0	0	0	0	0
256	244	0	0	0	0	0	0	0
276	365	365	365	0	365	365	365	0
277	365	0	0	0	0	0	0	0
278	306	0	0	0	0	0	0	0
301	0	365	365	365	365	365	365	365
326	365	184	0	0	0	0	0	0
327	303	334	365	273	306	214	306	0
351	365	334	0	0	0	0	0	0
376	0	31	92	0	31	31	31	0
377	0	184	0	0	0	0	0	0
401	0	92	31	0	0	0	61	0
501	303	0	0	0	0	0	0	0
516	0	154	0	0	0	0	0	0
521	365	0	0	0	0	0	0	0
531	304	0	0	0	0	0	0	0
541	0	153	0	0	0	0	0	0
551	365	0	0	0	0	0	0	0
561	365	0	0	0	0	0	0	0
566	365	0	0	0	0	0	0	0

Table VII. Data on CARB64, Number of Days with Data per Station per Variable

Station	Variables 8	12	15	18	21	23	29	31
101	366	366	366	0	366	366	366	0
102	0	275	0	0	0	0	0	0
103	0	275	0	0	0	0	0	0
104	335	0	0	0	0	0	0	0
106	0	275	0	0	366	366	366	0
107	0	275	0	0	0	0	0	0
126	0	366	366	0	336	306	306	122
127	0	366	0	0	0	0	0	0
128	0	366	0	0	0	0	0	0
151	304	366	366	92	305	305	305	61
153	0	366	366	274	243	243	0	0
160	0	275	0	0	0	0	0	0
161	0	275	0	0	0	0	0	0
176	0	366	366	366	335	335	335	122
201	274	366	366	366	152	152	152	0
202	366	0	0	0	0	0	0	0
226	94	366	366	0	366	366	366	61
227	213	0	0	0	0	0	0	0
252	276	366	366	0	366	366	366	61
253	183	0	0	0	0	0	0	0
254	306	0	0	0	0	0	0	0
255	307	0	0	0	0	0	0	0
276	366	366	366	0	366	366	366	0
277	274	0	0	0	0	0	0	0
278	274	366	0	0	0	0	0	0
301	0	366	366	366	366	366	366	365
302	0	306	31	0	31	31	31	31
326	335	335	0	0	0	0	0	0
327	366	366	366	0	366	366	366	184
328	0	31	0	0	0	0	0	0
351	366	366	366	0	366	366	366	0
376	0	366	366	0	366	366	366	92
401	306	366	366	0	0	0	366	122
451	0	335	0	0	0	0	0	0
521	366	0	0	0	0	0	0	0
531	184	0	0	0	0	0	0	0
541	0	304	0	0	0	0	0	0
551	244	0	0	0	0	0	0	0
556	123	0	0	0	0	0	0	0
561	60	0	0	0	0	0	0	0

Table VIII. Data on CARB65, Number of Days with Data per Station per Variable

Station	Variables							
	8	12	15	18	21	23	29	31
101	365	365	365	0	365	365	365	365
102	0	365	0	0	0	0	0	0
103	0	365	0	0	0	0	0	0
104	365	365	0	0	0	0	0	0
106	0	365	0	0	365	365	365	0
107	0	365	0	0	0	0	0	0
126	365	365	365	0	365	365	365	365
127	0	365	0	0	0	0	0	0
128	0	365	0	0	0	0	0	0
151	365	365	365	365	365	365	365	365
153	0	365	365	30	365	365	0	0
160	0	365	0	0	0	0	0	0
161	0	365	0	0	0	0	0	0
162	0	31	0	0	31	31	0	0
176	0	365	365	365	365	365	364	365
177	0	365	365	365	365	0	365	0
201	365	365	365	31	0	0	365	365
202	365	0	0	0	0	0	0	0
226	365	365	365	0	364	365	365	365
252	365	365	365	0	365	365	365	365
254	365	0	0	0	0	0	0	0
255	365	0	0	0	0	0	0	0
276	365	365	365	0	365	365	365	365
277	365	0	0	0	0	0	0	0
278	365	365	0	0	0	0	0	0
302	0	365	365	0	365	365	365	365
326	0	365	0	0	0	0	0	0
327	364	365	365	0	365	365	365	365
328	0	365	0	0	0	0	0	0
351	365	365	365	0	365	365	365	0
376	0	365	365	0	365	365	365	365
401	365	365	365	0	0	0	365	365
426	0	245	0	0	0	0	0	0
427	365	0	0	0	0	0	0	0
451	0	275	0	0	0	0	0	0
521	365	0	0	0	0	0	0	0
531	365	0	0	0	0	0	0	0
541	0	365	0	0	0	0	0	0
551	365	0	0	0	0	0	0	0
561	365	0	0	0	0	0	0	0
566	365	0	0	0	0	0	0	0

Table IX. Data on CARB66, Number of Days with Data per Station per Variable

Station	Variables 8	12	15	18	21	23	29	31
101	365	365	365	0	365	365	365	365
102	0	365	0	0	0	0	0	0
103	0	365	0	0	0	0	0	0
104	365	365	0	0	0	0	0	0
106	0	31	0	0	31	31	31	0
107	0	365	0	0	0	0	0	0
108	0	334	0	0	334	334	334	0
126	365	365	365	120	365	365	365	365
127	0	365	0	0	0	0	0	0
128	0	365	0	0	0	0	0	0
151	0	365	365	246	365	365	365	365
153	0	365	365	0	59	59	0	0
160	0	365	0	0	0	0	0	0
161	0	365	0	0	0	0	0	0
162	0	365	0	0	181	181	0	0
176	0	365	365	365	365	365	365	365
177	0	365	365	365	365	0	365	0
201	365	365	365	0	306	306	306	365
202	365	0	0	0	0	0	0	0
226	365	365	365	0	365	365	365	365
252	365	365	365	0	365	365	365	365
254	365	0	0	0	0	0	0	0
255	365	0	0	0	0	0	0	0
276	365	365	365	0	365	365	365	365
277	365	0	0	0	0	0	0	0
278	365	365	0	0	0	0	0	0
302	0	365	365	0	365	31	31	365
326	365	365	0	0	0	0	0	0
327	365	365	365	0	365	365	365	365
328	0	365	0	0	0	0	0	0
351	151	151	151	0	151	151	151	0
376	0	364	365	0	334	31	62	365
401	151	151	151	0	0	0	151	151
426	0	211	0	0	0	0	0	0
427	303	0	0	0	0	0	0	0
428	61	92	92	0	92	92	92	0
429	184	334	334	0	334	334	334	334
451	0	334	0	0	0	0	0	0
521	365	0	0	0	0	0	0	0
531	365	0	0	0	0	0	0	0
536	92	92	92	0	92	92	92	92
541	0	334	0	0	0	0	0	0
551	334	0	0	0	0	0	0	0
561	365	0	0	0	0	0	0	0
566	365	0	0	0	0	0	0	0
841	122	122	122	0	122	122	122	122

Table X. Data on CARB67, Number of Days with Data per Station per Variable

Station	Variables 8	12	15	18	21	23	29	31
101	365	365	365	0	365	365	365	334
102	0	273	0	0	0	0	0	0
103	0	365	0	0	0	0	0	0
104	365	365	0	0	0	0	0	0
107	0	365	0	0	0	0	0	0
108	184	365	0	0	365	365	365	31
110	0	122	0	0	0	0	0	0
126	365	365	365	306	365	365	365	365
127	0	120	0	0	0	0	0	0
128	0	365	0	0	0	0	0	0
132	31	0	0	0	0	0	0	0
151	0	365	365	365	365	365	365	365
153	0	273	273	0	212	181	181	0
154	0	0	0	0	31	31	31	0
160	0	303	0	0	0	0	0	0
161	0	365	0	0	0	0	0	0
162	0	334	334	0	306	276	276	0
164	0	184	0	0	0	0	0	0
165	0	57	48	0	57	57	57	0
176	0	365	365	365	335	365	365	365
177	0	365	365	365	365	153	365	0
178	0	245	245	245	30	30	0	0
201	365	365	365	0	365	365	365	365
202	365	0	0	0	0	0	0	0
226	365	365	365	0	365	365	365	365
252	365	365	365	0	365	365	365	365
254	365	0	0	0	0	0	0	0
255	365	0	0	0	0	0	0	0
276	365	365	365	0	365	365	365	365
277	365	0	0	0	0	0	0	0
278	365	365	0	0	0	0	0	0
302	31	365	365	0	365	365	365	365
326	365	181	0	0	0	0	0	0
327	366	365	365	0	365	365	365	365
328	0	365	0	0	0	0	0	0
331	31	275	0	0	0	0	0	0
376	61	365	365	0	365	365	365	365
426	0	365	0	0	0	0	0	0
427	365	0	0	0	0	0	0	0
428	365	365	365	0	365	365	365	275

Table X. Continued

Station	Variables							
	8	12	15	18	21	23	29	31
429	303	365	365	0	365	365	365	273
451	122	365	92	0	92	92	92	92
521	365	0	0	0	0	0	0	0
531	364	0	0	0	0	0	0	0
536	337	365	365	0	365	365	365	365
537	214	275	0	0	0	0	0	0
541	245	365	306	0	306	306	306	275
543	0	184	0	0	0	0	0	0
551	335	0	0	0	0	0	0	0
561	366	0	0	0	0	0	0	0
566	365	0	0	0	0	0	0	0
841	365	365	365	0	365	365	365	365

Table XI. Data on CARB68, Number of Days with Data per Station per Variable

Station	Variables							
	8	12	15	18	21	23	29	31
101	336	366	366	0	366	366	366	366
103	0	366	0	0	0	0	0	0
104	366	366	0	0	0	0	0	0
107	0	366	0	0	0	0	0	0
108	366	366	0	0	366	366	366	0
110	0	366	0	0	0	0	0	0
126	366	366	366	366	366	366	366	366
128	0	366	0	0	0	0	0	0
132	361	0	0	0	0	0	0	0
151	0	366	366	366	366	366	366	366
160	0	366	0	0	0	0	0	0
161	0	366	0	0	0	0	0	0
162	0	335	366	0	366	366	366	0
164	0	366	0	0	0	0	0	0
165	0	366	366	0	366	366	366	0
168	0	245	0	0	0	0	0	0
176	366	366	366	336	366	366	366	366
177	0	366	366	366	366	366	366	0
178	0	366	366	366	0	0	0	0
201	366	366	366	0	366	366	366	366
202	366	0	0	0	0	0	0	0
226	366	366	366	0	366	366	366	366
252	366	366	366	0	366	366	366	366
254	366	0	0	0	0	0	0	0
255	366	0	0	0	0	0	0	0
257	0	0	335	0	0	0	0	0
276	366	366	366	0	366	366	366	366
277	366	0	0	0	0	0	0	0
278	366	366	0	0	0	0	0	0
302	335	335	335	0	335	335	335	335
303	122	122	122	0	122	122	122	122
326	366	0	0	0	0	0	0	0
327	366	366	366	0	366	366	366	366
328	0	366	0	0	0	0	0	0
331	366	366	0	0	0	0	0	0
333	332	324	0	0	0	0	0	184
351	366	0	0	0	0	0	0	0
376	366	366	366	0	366	366	366	366
378	0	366	0	0	0	0	0	0
426	0	366	0	0	0	0	0	0
427	366	0	0	0	0	0	0	0
428	366	366	366	0	366	366	366	366
429	335	335	335	0	335	335	335	335

Table XI. Continued

Station	Variables							
	8	12	15	18	21	23	29	31
430	31	31	31	0	31	31	31	31
451	366	366	366	0	366	366	366	366
521	366	0	0	0	0	0	0	0
531	366	0	0	0	0	0	0	0
536	366	366	366	0	366	366	366	366
537	365	366	0	0	0	0	0	0
538	0	366	366	0	366	366	366	366
541	366	366	366	0	366	366	366	366
544	366	366	0	0	0	0	0	366
551	366	0	0	0	0	0	0	0
552	61	0	0	0	0	0	0	0
561	366	0	0	0	0	0	0	0
566	366	0	0	0	0	0	0	0
841	366	366	366	0	366	366	366	366

Table XII. Data on CARB69, Number of Days with Data per Station per Variable

Station	Variables 8	12	15	18	21	23	29	31
101	365	365	365	0	365	365	365	365
103	0	365	0	0	0	0	0	0
104	365	365	0	0	0	0	0	0
107	0	365	0	0	0	0	0	0
108	0	365	0	0	365	365	365	0
110	0	365	0	0	0	0	0	0
126	362	365	365	365	365	365	365	365
128	0	365	0	0	0	0	0	0
132	364	0	0	0	0	0	0	0
136	365	0	0	0	0	0	0	0
151	365	365	365	365	365	365	365	365
155	0	365	0	0	0	0	0	0
162	365	365	365	0	365	365	365	0
164	0	365	0	0	0	0	0	0
165	365	365	365	0	365	365	365	0
168	365	365	0	0	0	0	0	0
176	365	365	365	365	365	365	365	365
177	0	365	365	365	365	365	365	0
178	0	365	365	365	0	0	0	0
201	365	365	365	0	365	365	365	365
202	365	0	0	0	0	0	0	0
226	365	365	365	0	365	365	365	365
227	0	365	365	0	0	0	0	0
228	0	365	365	0	365	365	365	365
252	365	365	365	0	365	365	365	365
254	365	0	0	0	0	0	0	0
255	365	0	0	0	0	0	0	0
257	0	0	365	0	0	0	0	0
276	365	365	365	0	365	365	365	365
277	365	0	0	0	0	0	0	0
278	365	365	0	0	0	0	0	0
303	365	365	365	0	365	365	365	365
326	365	0	0	0	0	0	0	0
328	0	365	0	0	0	0	0	0
331	365	365	0	0	0	0	0	0
333	365	365	365	0	0	0	0	365
334	365	365	365	0	365	365	365	365
335	0	365	365	0	365	0	0	365
351	365	0	0	0	0	0	0	0
352	365	0	0	0	0	0	0	0
353	365	0	0	0	0	0	0	0
376	365	365	365	0	365	365	365	365

Table XII. Continued

Station	Variables							
	8	12	15	18	21	23	29	31
401	0	153	0	0	153	153	153	0
402	0	0	365	0	0	0	0	0
407	0	365	0	0	365	365	365	0
426	0	365	0	0	0	0	0	0
428	365	365	365	0	365	365	365	365
430	365	365	365	0	365	365	365	365
451	365	365	365	0	365	365	365	365
521	365	0	0	0	0	0	0	0
531	365	0	0	0	0	0	0	0
536	365	365	365	0	365	365	365	365
537	365	365	0	0	0	0	0	0
538	0	365	365	0	365	365	365	365
541	365	365	365	0	365	365	365	365
544	365	365	365	0	0	0	0	365
551	365	0	0	0	0	0	0	365
552	273	0	0	0	0	0	0	0
561	212	0	0	0	0	0	0	0
566	365	0	0	0	0	0	0	0
751	365	0	0	0	0	0	0	0
752	365	0	0	0	0	0	0	0
753	365	0	0	0	0	0	0	0
781	0	0	365	0	0	0	0	0
841	365	365	0	0	365	365	365	0
871	0	92	0	0	92	92	92	0
872	365	365	0	0	365	365	365	0
881	365	365	365	0	365	365	365	365

Table XIII. Data on CARB70, Number of Days with Data per Station per Variable

Station	Variables							
	8	12	15	18	21	23	29	31
1	0	365	365	365	365	365	365	365
59	0	365	365	365	365	365	365	365
60	0	365	365	365	365	365	365	365
71	0	365	365	365	365	365	365	0
72	0	365	365	365	365	365	365	0
74	0	365	365	365	365	365	365	365
75	0	365	365	365	365	365	365	365
76	0	365	365	365	365	365	365	365
78	0	0	0	365	0	0	0	0
79	0	365	365	365	365	365	365	365
80	0	365	365	0	365	365	365	365
81	0	365	365	0	365	365	365	365
82	0	365	365	0	365	365	365	365
101	365	365	365	0	365	365	365	365
103	0	365	0	0	0	0	0	0
104	365	365	0	0	0	0	0	0
107	0	365	0	0	0	0	0	0
108	0	365	0	0	365	365	365	0
110	0	365	0	0	0	0	0	0
126	365	365	365	365	365	365	365	365
128	0	365	0	0	0	0	0	0
132	365	0	0	0	0	0	0	0
133	0	365	0	0	0	0	0	0
136	365	0	0	0	0	0	0	0
151	365	365	365	365	365	365	365	365
152	0	365	362	0	365	365	365	0
155	365	365	0	0	0	0	0	0
162	0	365	0	0	0	0	0	0
164	0	365	0	0	0	0	0	0
165	365	365	365	0	365	365	365	0
168	365	365	0	0	0	0	0	0
176	365	365	365	365	365	365	365	365
177	365	365	0	365	365	365	365	0
178	0	365	0	365	0	0	0	0
182	0	365	0	365	365	365	365	0
201	365	365	365	0	365	365	365	365
202	365	0	0	0	0	0	0	0
226	365	365	0	0	0	0	0	0
227	0	0	365	0	0	0	0	0
228	0	365	365	0	365	365	365	365
252	365	365	365	0	365	365	365	365
254	365	0	0	0	0	0	0	365
255	365	0	0	0	0	0	0	0
257	0	0	365	0	0	0	0	0

Table XIII. Continued

Station	Variables							
	8	12	15	18	21	23	29	31
276	365	365	365	0	365	365	365	365
277	365	0	0	0	0	0	0	0
278	365	365	0	0	0	0	0	0
281	0	365	0	0	365	365	365	0
303	365	365	365	0	365	365	365	365
326	365	0	0	0	0	0	0	0
327	365	0	0	0	0	0	0	0
328	0	365	0	0	0	0	0	0
331	365	365	0	0	0	0	0	0
333	365	365	365	0	0	0	0	365
334	365	365	365	0	365	365	365	365
335	334	365	365	0	365	0	0	365
351	365	0	0	0	0	0	0	0
352	365	365	0	0	0	0	0	0
353	365	0	0	0	0	0	0	0
376	151	151	151	0	151	151	151	151
379	214	214	214	0	214	214	214	214
401	0	365	0	0	365	365	365	0
402	0	365	365	0	365	365	365	0
407	0	365	365	0	365	365	365	0
426	0	365	0	0	0	0	0	0
428	365	365	365	0	365	365	365	365
430	365	365	365	0	365	365	365	365
451	365	365	365	0	365	365	365	365
521	365	0	0	0	0	0	0	0
531	365	0	0	0	0	0	0	0
536	365	365	0	0	365	365	365	365
537	365	365	0	0	0	0	0	0
538	365	365	365	0	365	365	365	365
541	365	365	365	0	365	365	365	365
544	365	365	365	0	0	0	0	365
553	365	365	365	0	365	365	365	365
556	365	365	365	0	365	365	365	365
561	334	365	365	0	365	365	365	365
621	365	365	365	0	365	365	365	365
751	365	0	0	0	0	0	0	0
752	365	0	0	0	0	0	0	0
753	365	0	0	0	0	0	0	0
781	365	0	365	0	0	0	0	0
782	0	365	0	0	0	0	0	0
831	365	365	365	0	365	365	365	365
841	365	365	0	0	365	365	365	0
871	0	365	0	0	365	365	365	0
872	365	365	0	0	0	0	0	0
873	365	365	365	0	365	365	365	365
881	365	365	365	0	365	365	365	365

Table XIV. Data on CARB71, Number of Days with Data per Station per Variable

Station	Variables							
	8	12	15	18	21	23	29	31
101	365	365	365	0	365	365	365	365
103	0	365	0	0	0	0	0	0
104	365	365	0	0	24	24	24	0
107	0	365	0	0	0	0	0	0
108	0	365	0	0	365	365	365	0
110	0	365	0	0	0	0	0	0
126	365	365	365	334	365	365	365	365
128	0	355	0	0	0	0	0	0
133	184	350	0	31	306	306	306	0
136	120	0	0	0	0	0	0	0
137	61	306	92	61	256	256	256	61
138	153	0	0	0	0	0	0	0
139	275	306	245	0	276	276	276	122
140	0	11	0	0	0	0	0	0
151	365	365	365	365	365	365	365	365
152	0	365	273	0	365	365	365	0
155	365	181	0	0	0	0	0	0
164	0	59	0	0	0	0	0	0
165	365	365	365	0	365	365	365	0
166	31	0	0	0	0	0	0	0
168	214	365	0	0	0	0	0	0
169	365	0	0	0	0	0	0	0
171	13	0	0	0	0	0	0	0
176	365	365	92	365	365	365	365	365
177	365	365	61	365	365	365	365	0
178	0	365	61	365	365	365	365	0
183	0	306	0	122	306	306	306	0
184	0	0	0	184	0	0	0	0
201	243	365	212	0	225	225	225	243
202	365	0	0	0	0	0	0	0
203	214	214	153	0	214	214	214	153
226	365	59	0	0	0	0	0	0
228	0	365	365	0	365	365	365	365
252	365	365	365	0	365	365	365	365
254	334	0	0	0	0	0	0	0
255	365	0	0	0	0	0	0	0
257	0	0	365	0	0	0	0	0
276	365	365	365	0	365	365	365	365
277	365	0	0	0	0	0	0	0
278	334	365	0	0	0	0	0	0
281	0	365	365	0	365	365	365	306
292	184	31	0	0	31	31	31	0
303	365	365	365	0	365	365	365	365
328	0	365	0	0	0	0	0	0

Table XIV. Continued

Station	Variables 8	12	15	18	21	23	29	31
331	0	181	0	0	0	0	0	0
334	365	365	365	0	365	365	365	365
335	365	365	365	0	365	365	365	365
336	365	365	365	0	0	0	0	365
352	0	365	0	0	0	0	0	0
354	120	214	214	0	214	214	214	214
379	365	365	365	0	365	365	365	365
402	0	365	365	0	365	365	365	0
407	0	259	167	0	259	259	259	0
408	0	106	106	0	106	106	106	0
409	0	0	0	0	31	31	31	0
426	0	365	0	0	0	0	0	0
428	365	365	365	184	365	365	365	365
430	365	365	365	0	365	365	365	365
431	0	0	0	184	0	0	0	0
432	0	0	0	153	0	0	0	0
451	365	365	365	0	365	365	365	365
503	0	122	0	0	0	0	0	0
521	365	0	0	0	0	0	0	0
531	365	0	0	0	0	0	0	0
536	365	365	0	0	365	365	365	365
537	365	365	0	0	0	0	0	0
538	365	365	365	0	365	365	365	0
541	365	365	365	0	365	365	365	365
544	365	365	365	0	0	0	0	365
553	365	365	365	0	365	365	365	365
557	365	365	365	0	365	365	365	365
561	214	365	365	0	365	365	365	365
621	365	365	365	0	365	365	365	365
752	273	0	0	0	0	0	0	0
753	273	0	0	0	0	0	0	0
754	273	0	0	0	0	0	0	0
781	365	0	365	0	0	0	0	0
782	0	365	0	0	0	0	0	0
831	365	365	365	0	365	365	365	365
841	365	365	0	0	365	0	0	0
872	365	365	0	0	0	0	0	0
873	365	365	365	0	365	365	365	365
881	120	120	120	0	120	120	120	120
882	245	245	245	0	245	245	245	245
891	184	184	0	0	184	184	184	153

Table XV. Data on CARB72, Number of Days with Data per Station per Variable

Station	Variables							
	8	12	15	18	21	23	29	31
101	336	366	366	306	366	366	365	366
103	0	366	0	0	0	0	0	0
104	366	366	184	245	366	366	366	184
108	0	244	0	0	244	244	244	0
110	0	366	0	0	0	0	0	0
114	0	366	0	0	0	0	0	0
115	0	245	0	0	0	0	0	0
120	31	31	31	31	31	31	31	31
121	0	31	31	0	31	31	31	0
126	244	244	244	214	244	244	244	244
133	0	366	0	0	0	0	0	0
137	0	366	92	0	366	366	366	0
139	366	366	366	214	366	366	366	366
140	0	366	182	153	366	366	366	244
142	153	184	184	0	184	184	184	184
143	0	0	122	0	0	0	0	0
144	122	122	122	92	122	122	122	122
145	0	0	92	0	0	0	0	0
146	0	61	0	0	61	61	61	0
151	336	366	366	366	366	366	366	366
152	0	306	335	0	243	243	243	0
155	244	152	0	0	0	0	0	0
165	365	366	366	0	366	366	366	0
166	335	0	0	0	0	0	0	0
168	366	366	0	0	0	0	0	0
169	304	0	0	0	0	0	0	0
170	0	335	0	0	0	0	0	0
171	335	0	0	0	0	0	0	0
172	0	60	0	0	0	0	0	0
176	365	366	366	365	366	366	366	366
177	366	366	366	366	366	366	366	0
178	0	31	31	31	31	31	31	0
184	0	366	366	366	366	366	365	0
185	31	366	366	366	366	366	366	0
201	0	91	0	0	0	0	0	0
202	335	0	0	0	0	0	0	0
203	366	366	366	0	366	366	366	366
208	0	153	0	0	0	0	0	0
226	365	0	0	0	0	0	0	0
228	0	366	366	0	366	366	366	366
229	365	366	366	0	0	0	0	0
230	365	366	306	0	0	0	0	0
252	365	366	366	0	366	366	366	366

Table XV. Continued

Station	Variables							
	8	12	15	18	21	23	29	31
255	366	0	0	0	0	0	0	0
257	0	0	31	0	0	0	0	0
277	366	0	0	0	0	0	0	0
278	366	366	0	0	0	0	0	0
281	0	152	152	0	152	152	152	152
282	366	366	366	0	366	366	366	366
303	366	366	366	0	366	366	366	306
328	61	366	0	0	0	0	0	0
334	366	366	366	0	366	366	366	366
335	366	366	366	0	366	0	0	366
336	366	366	366	0	0	0	0	366
352	0	366	0	0	0	0	0	0
354	366	366	366	0	366	366	366	60
355	306	335	335	0	335	335	335	335
379	244	244	244	0	244	244	244	244
380	335	335	0	0	0	0	0	0
381	335	335	0	0	0	0	0	0
382	153	153	153	0	153	153	153	153
402	0	336	366	0	366	366	366	0
408	0	366	366	0	366	366	366	366
409	0	0	0	0	366	366	366	0
411	0	153	0	0	0	0	0	0
426	0	366	0	0	0	0	0	0
428	60	60	60	60	60	60	60	60
430	366	366	366	366	366	366	366	366
431	0	0	0	366	0	0	0	0
432	0	0	0	366	0	0	0	0
433	306	306	306	306	275	275	275	306
434	0	0	0	245	0	0	0	0
435	0	0	0	184	0	0	0	0
436	92	92	92	31	0	0	0	0
451	366	366	366	0	366	366	366	366
503	245	366	0	0	245	245	245	0
521	366	0	0	0	0	0	0	0
531	335	0	0	0	0	0	0	0
536	366	366	0	0	366	366	366	366
537	366	366	0	0	0	0	0	0
538	366	366	366	0	366	366	366	0
541	366	366	366	0	366	366	366	366
544	60	60	60	0	0	0	0	60
545	275	275	275	0	0	0	0	275
553	366	366	366	0	366	366	366	366
557	366	366	366	0	366	366	366	366
561	366	366	366	0	366	366	366	366

Table XV. Continued

Station	Variables							
	8	12	15	18	21	23	29	31
621	366	366	366	0	366	366	366	366
703	0	153	0	0	0	0	0	0
781	213	0	213	0	0	0	0	0
782	0	213	0	0	0	0	0	0
783	306	306	306	0	275	275	275	306
831	366	366	366	0	366	366	366	366
841	366	366	0	0	366	0	0	0
842	275	0	0	0	0	0	0	0
843	153	184	122	0	184	184	184	184
872	213	213	0	0	0	0	0	0
873	182	182	182	0	182	182	182	182
874	306	306	275	0	275	275	275	275
875	306	306	0	0	0	0	0	0
882	182	213	213	0	213	213	213	213
883	306	306	0	0	0	0	0	0
884	153	153	153	0	153	153	153	153
891	366	366	0	0	366	366	366	366

Table XVI. Data on CARB73, Number of Days with Data per Station per Variable

Station	Variables							
	12	15	18	21	23	29	31	36
1	365	365	365	365	365	365	365	0
60	365	365	365	365	365	365	365	0
69	365	365	365	365	365	365	365	0
71	365	365	365	365	365	365	0	0
72	365	365	365	365	365	365	0	0
74	365	365	365	365	365	365	365	0
75	365	365	365	365	365	365	365	0
76	365	365	365	365	365	365	365	0
78	0	0	304	0	0	0	0	0
80	365	365	365	365	365	365	365	0
81	365	365	365	365	365	365	365	0
82	365	365	0	365	365	365	365	0
83	365	365	365	365	365	365	365	0
84	92	92	92	92	92	92	0	0
103	365	0	0	0	0	0	0	0
104	365	334	365	365	365	365	365	0
114	365	0	0	0	0	0	0	0
115	365	0	0	0	0	0	0	0
120	365	365	365	365	365	365	365	0
121	365	365	0	365	337	337	214	0
133	0	0	0	0	0	0	0	120
137	365	365	0	365	365	365	0	0
139	365	365	365	365	365	365	365	0
140	365	365	0	365	365	365	365	0
141	0	0	0	0	0	0	0	365
142	59	59	0	59	59	59	59	0
143	0	151	0	0	0	0	0	0
144	365	365	365	365	365	365	365	0
145	0	151	0	0	0	0	0	0
146	365	275	0	365	365	365	275	0
148	183	0	0	0	0	0	0	0
149	0	0	0	0	0	0	0	245
150	0	0	0	0	0	0	0	245
151	365	365	365	365	365	365	365	184
155	0	92	0	92	92	92	0	92
165	31	365	0	365	365	365	0	365
168	365	92	0	92	92	92	0	92
170	89	0	0	0	0	0	0	31
173	0	365	0	365	365	365	0	365
174	0	334	0	334	334	334	0	334
175	306	306	0	306	306	306	306	0
176	365	549	396	488	457	457	365	214
177	365	365	365	365	365	365	0	92

Table XVI. Continued

Station	Variables							
	12	15	18	21	23	29	31	36
181	0	0	0	0	0	0	0	30
185	365	365	365	365	365	365	0	0
186	365	365	214	365	365	365	0	0
188	0	0	0	0	0	0	0	153
203	365	365	0	365	365	365	365	0
208	31	0	0	0	0	0	0	0
228	365	365	0	365	365	365	365	0
229	334	334	303	0	0	0	0	0
230	334	334	0	0	0	0	0	0
252	365	365	0	365	365	365	365	0
278	365	0	0	0	0	0	0	0
282	365	365	0	365	365	365	365	273
303	365	365	0	365	365	365	365	0
328	365	0	0	0	0	0	0	0
334	365	365	0	365	365	365	365	0
335	365	365	0	365	0	0	365	0
336	365	365	0	0	0	0	365	0
337	122	0	0	0	0	0	0	0
352	365	0	0	0	0	0	0	0
354	31	0	0	31	31	31	0	0
355	365	365	0	365	365	365	365	0
358	306	0	0	0	0	0	0	0
380	365	0	0	0	0	0	0	0
381	365	0	0	0	0	0	0	0
382	365	365	0	365	365	365	365	0
384	122	122	0	122	92	92	0	0
401	0	0	0	0	0	0	0	90
402	212	181	0	243	243	243	0	334
404	0	0	0	0	0	0	0	365
408	365	334	306	365	365	365	365	306
409	0	0	0	365	365	365	0	153
412	0	0	0	153	0	0	153	306
413	0	0	0	0	0	0	0	151
414	0	61	0	0	0	0	0	275
415	0	0	0	0	0	0	0	265
426	365	0	0	0	0	0	0	0
430	365	365	365	365	365	365	365	0
431	0	0	365	0	0	0	0	0
432	0	0	365	0	0	0	0	0
433	365	365	365	365	61	61	365	0
434	0	0	365	0	0	0	0	0
435	0	0	31	0	0	0	0	0
436	365	365	365	334	0	0	0	0
451	365	365	0	365	365	365	365	0
503	365	0	0	365	365	365	0	0

Table XVI. Continued

Station	Variables							
	12	15	18	21	23	29	31	36
536	365	31	0	365	365	365	365	0
537	365	0	0	0	0	0	0	0
538	365	365	0	365	365	365	0	0
539	334	0	0	0	0	0	0	0
541	365	365	0	365	365	365	365	0
545	365	365	0	0	0	0	365	0
553	365	365	0	365	365	365	365	0
557	365	365	0	365	365	365	365	0
561	365	365	0	365	365	365	365	0
621	365	365	0	365	365	365	365	0
703	31	0	0	0	0	0	0	0
783	365	365	0	365	365	365	365	0
821	245	92	0	245	245	245	245	0
831	365	365	0	365	365	365	365	0
841	365	0	0	365	0	0	0	0
843	120	120	0	120	120	120	59	0
874	365	365	31	365	365	365	365	0
875	365	0	0	0	0	0	0	0
876	0	0	334	0	0	0	0	0
883	365	0	0	0	0	0	0	0
884	365	365	0	365	365	365	365	0
891	365	214	0	365	365	365	365	0

Table XVII. Data on LAT059, Number of Months with Data per Station per Variable

STATION	VARIABLES																	
	12	15	18	21	23	24	25	27	29	30	33	36	39	41	60	61	74	76	78
1	48	42	22	10	6	23	4	4	6	10	24	6	0	1	11	43	0	0	0
2	23	24	0	15	0	0	15	15	0	6	16	0	0	0	0	0	0	0	0
3	20	13	0	11	0	0	11	11	0	3	1	0	0	0	0	0	0	0	0
4	33	33	33	27	1	13	27	27	1	22	32	4	0	0	2	9	0	0	0
5	37	45	4	22	0	0	22	22	0	9	19	3	0	0	14	0	0	0	0
6	19	21	0	13	0	0	12	12	0	3	8	0	0	0	0	0	0	0	0
7	15	15	0	5	0	0	4	4	0	3	4	0	0	0	0	0	0	0	0
8	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	51	51	34	42	17	0	26	26	17	14	35	16	0	7	20	0	0	0	0
10	2	0	0	12	0	0	12	12	0	0	0	0	0	0	0	0	0	0	0
11	21	11	0	11	0	0	11	11	0	3	1	0	0	0	0	0	0	0	0
12	28	31	10	22	0	0	22	22	0	4	5	0	0	0	3	0	0	0	0
13	29	29	29	23	0	0	23	23	0	9	11	0	0	0	3	0	0	53	31
14	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	48	48	48	36	10	17	27	27	10	20	29	9	23	31	18	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0
30	2	1	2	2	2	0	0	0	2	0	0	0	0	2	2	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	120	31
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	53	0
50	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	0	0	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	5	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
54	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	46	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14	0
56	14	5	0	0	0	14	0	0	0	5	8	0	0	0	0	0	0	0	0
57	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	34	33	34	34	11	0	24	24	11	22	34	13	0	0	18	0	0	0	0
59	14	13	13	14	0	0	14	14	0	5	6	0	0	11	3	0	0	0	0
60	36	30	0	36	16	0	21	21	16	9	27	19	0	34	24	0	0	0	0
61	28	28	17	28	17	0	12	12	17	7	24	19	0	15	24	0	0	0	0
62	21	21	21	21	16	0	6	6	16	8	16	19	0	0	22	0	0	0	0
63	14	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0
64	16	15	15	15	15	0	0	0	15	3	16	16	0	11	15	0	0	0	0

Table XVIII. Data on LA6064, Number of Months with Data per Station per Variable

STATION	12	15	17	18	19	20	21	23	29	31	33	35	36	41	60	74	76	78	80
	VARIABLES																		
1	60	60	7	60	0	0	60	60	60	33	59	14	60	60	60	0	0	0	0
9	22	22	0	22	0	0	22	22	22	0	22	0	22	20	22	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	60
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	10
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	60
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	54	55	54
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	0	60
51	0	0	0	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	60	60	0	0	0	0	60	60	60	34	59	0	60	20	60	0	0	0	0
61	35	34	0	35	0	0	35	35	35	0	34	0	35	35	35	46	46	0	46
62	34	34	0	34	0	0	34	34	34	0	33	0	25	0	34	0	0	0	0
64	60	59	0	60	0	0	60	60	60	0	59	0	60	60	60	0	0	0	0
65	35	30	0	35	0	0	35	35	35	0	35	0	34	35	35	0	0	0	0
67	29	29	0	0	0	0	29	29	29	0	0	0	29	29	29	0	0	0	0
68	26	20	0	17	15	15	26	26	26	0	18	0	26	20	26	0	0	0	0
69	39	24	0	38	0	0	38	38	38	35	38	0	37	13	38	0	0	0	0
70	36	36	0	0	0	0	36	36	36	34	0	11	0	0	36	0	0	0	0
71	26	26	0	26	0	0	26	26	26	0	25	0	26	24	26	0	0	0	0
72	26	27	0	27	0	0	27	27	27	18	12	0	27	0	27	0	0	0	0
73	22	21	0	0	0	0	21	21	21	21	0	0	0	0	22	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	6	6
89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	0	60

TABLE XIX. Data on LA6569, Number of Months with Data per Station per Variable

STATION	VARIABLES																		
	12	15	18	19	20	21	23	29	31	32	33	35	36	41	60	74	76	78	80
1	60	60	60	19	0	60	60	60	59	46	58	0	8	58	60	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	59	60
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	60
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	0	60
51	0	0	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	60	60	0	0	0	58	58	58	33	28	60	0	8	0	60	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	0	60
64	45	45	45	0	0	45	45	45	24	24	45	0	8	33	45	0	0	0	0
68	2	2	2	0	0	2	2	2	0	0	1	0	2	2	2	0	0	0	0
69	60	60	60	0	0	60	60	60	5	0	59	0	8	31	60	0	0	0	0
70	35	36	0	0	0	36	36	36	34	0	0	9	0	0	36	0	0	0	0
71	60	60	60	0	0	60	60	60	12	12	59	0	8	34	60	0	0	0	0
72	60	60	60	0	0	60	60	60	21	0	57	0	8	0	60	0	0	0	0
73	30	30	0	0	0	30	30	30	28	0	0	0	0	0	30	0	0	0	0
74	58	58	51	0	0	58	58	58	0	0	56	0	0	0	58	0	0	0	0
75	55	55	52	0	0	55	55	55	0	0	55	0	0	0	55	60	60	60	60
76	59	59	59	56	57	59	59	59	3	3	56	0	7	33	59	0	0	0	0
78	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	17	17	16	0	0	17	17	17	16	16	16	0	0	0	16	0	0	0	0
80	5	5	0	0	0	5	5	5	0	0	4	0	0	0	0	0	0	0	0
81	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	59	0	60
299	17	17	17	0	0	17	17	17	17	0	0	4	0	0	4	0	0	0	0

Table XX. Data on LA7071, Number of Months with Data per Station per Variable

STATION	VARIABLES															
	12	15	18	20	21	23	29	31	32	33	41	60	74	76	78	80
1	28	28	28	0	28	28	28	28	28	25	18	28	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	8	28	28	28
21	0	0	0	0	0	0	0	0	0	0	0	0	8	26	0	26
41	0	0	0	0	0	0	0	0	0	0	0	0	28	26	0	26
60	28	28	25	0	28	28	28	28	28	28	0	19	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	28	26	0	26
69	28	58	28	0	28	28	28	23	23	26	0	20	0	0	0	0
71	28	28	28	0	28	28	28	0	0	25	0	20	0	0	0	0
72	28	28	28	0	28	28	28	0	0	27	0	20	0	0	0	0
74	28	28	28	0	28	28	28	23	23	25	0	19	0	0	0	0
75	29	28	28	0	28	28	28	24	24	28	0	20	28	26	28	26
76	28	28	28	25	28	28	28	24	24	28	0	28	0	0	0	0
78	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0
79	28	28	28	0	28	28	28	28	28	27	0	20	0	0	0	0
80	28	28	6	0	28	28	28	25	23	28	0	0	0	0	0	0
81	28	25	0	0	20	20	20	25	25	19	0	17	0	0	0	0
82	18	22	0	0	17	17	17	22	22	10	0	17	0	0	0	0
89	0	0	0	0	0	0	0	0	0	0	0	0	28	26	0	26
202	0	7	0	0	0	0	0	0	0	0	0	7	0	0	0	0
203	0	7	0	0	0	0	0	0	0	0	0	7	0	0	0	0
204	0	7	0	0	0	0	0	0	0	0	0	7	0	0	0	0
205	0	2	0	0	0	0	0	0	0	0	0	6	0	0	0	0
206	0	7	0	0	0	0	0	0	0	0	0	7	0	0	0	0
207	0	7	0	0	0	0	0	0	0	0	0	7	0	0	0	0
208	0	7	0	0	0	0	0	0	0	0	0	7	0	0	0	0
209	0	7	0	0	0	0	0	0	0	0	0	7	0	0	0	0
299	26	26	26	0	26	26	26	26	0	0	0	11	0	0	0	0

Table XXI. Data on LA72, Number of Months with Data per Station per Variable

STATION	VARIABLES																	
	11	12	14	15	18	20	21	23	29	31	32	33	60	74	76	78	80	90
1	4	12	4	12	12	0	12	12	12	12	12	10	12	0	0	0	0	12
13	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12	12	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	0	12	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	0	12	0
60	4	12	4	12	12	0	12	12	12	12	12	12	12	0	0	0	0	12
61	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	0	12	0
69	4	12	4	12	12	0	12	12	12	12	12	12	12	0	0	0	0	12
71	0	12	0	12	12	0	12	12	12	0	0	10	12	0	0	0	0	12
72	0	12	0	12	12	0	12	12	12	0	0	12	12	0	0	0	0	12
74	4	12	4	12	12	0	12	12	12	12	12	9	12	0	0	0	0	12
75	4	12	4	12	12	0	12	12	12	12	12	12	12	12	12	12	12	12
76	4	12	4	12	12	1	12	12	12	12	12	12	12	0	0	0	0	12
78	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0
79	0	5	0	5	5	0	5	5	5	5	5	4	5	0	0	0	0	5
80	4	12	4	12	12	0	12	12	12	12	12	12	0	0	0	0	0	12
81	4	12	4	12	3	0	12	12	12	12	12	11	12	0	0	0	0	12
82	4	12	4	12	0	0	12	12	12	12	12	10	12	0	0	0	0	12
83	4	8	4	8	8	0	8	8	8	8	8	8	8	0	0	0	0	8
89	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	0	12	0
252	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
299	1	4	0	4	4	0	4	4	4	4	0	0	0	0	0	0	0	0

Table XXII. Data on LAMET, Number of Months with Data per Station per Variable

STATION	Variable			
	74	76	78	80
13	24	24	24	24
21	24	24	0	24
41	24	24	0	24
61	24	24	0	24
75	24	24	0	24
89	16	16	0	16
129	8	8	0	8

Table XXIII. Data on WINDONE

Year	Station	Number of Days	Year	Station	Number of Days
0	0	0	1958	9	365
1955	1	30	1959	9	365
1956	1	338	1960	9	344
1957	1	315	1961	9	365
1955	2	30	1962	9	365
1956	2	364	1963	9	365
1957	2	365	1964	9	366
1958	2	357	1965	9	365
1959	2	355	1966	9	356
1960	2	350	1967	9	342
1961	2	364	1968	9	356
1962	2	358	1969	9	251
1963	2	365	1970	9	249
1964	2	365	1955	10	61
1965	2	358	1956	10	357
1966	2	365	1957	10	365
1967	2	364	1958	10	365
1968	2	365	1959	10	362
1969	2	354	1960	10	195
1970	2	359	1966	12	276
1971	2	363	1967	12	365
1955	4	30	1968	12	366
1956	4	287	1969	12	324
1957	4	361	1970	12	364
1958	4	365	1955	13	153
1959	4	364	1956	13	366
1960	4	366	1957	13	365
1961	4	81	1958	13	365
1955	5	30	1959	13	365
1956	5	358	1960	13	366
1957	5	365	1961	13	365
1958	5	365	1962	13	365
1959	5	365	1963	13	365
1960	5	366	1964	13	366
1961	5	365	1965	13	365
1962	5	365	1966	13	365
1963	5	365	1967	13	365
1964	5	365	1968	13	366
1965	5	365	1969	13	365
1966	5	363	1970	13	365
1967	5	365	1971	13	365
1968	5	366	1972	13	152
1969	5	365	1955	14	28
1970	5	361	1956	14	260
1955	6	30	1957	14	362
1956	6	356	1958	14	357
1957	6	358	1959	14	360
1958	6	365	1960	14	341
1959	6	88	1961	14	361
1955	7	122	1962	14	361
1956	7	31	1963	14	365
1955	8	30	1964	14	364
1956	8	366	1965	14	365
1957	8	365	1966	14	363
1956	9	310	1967	14	360
1957	9	365			

Table XXIII. Continued

Year	Station	Number of Days	Year	Station	Number of Days
1968	14	366	1965	22	365
1969	14	328	1966	22	171
1970	14	349	1967	22	365
1955	17	30	1969	22	366
1956	17	366	1969	22	365
1957	17	365	1970	22	359
1955	18	30	1955	23	30
1956	18	366	1956	23	366
1957	18	364	1957	23	351
1958	18	331	1958	23	267
1959	18	76	1959	23	224
1955	19	30	1955	24	23
1956	19	340	1956	24	337
1957	19	349	1957	24	286
1958	19	352	1958	24	356
1959	19	350	1959	24	357
1960	19	180	1960	24	347
1955	20	30	1961	24	333
1956	20	365	1962	24	365
1957	20	365	1963	24	361
1958	20	365	1964	24	363
1959	20	365	1965	24	365
1960	20	303	1966	24	102
1963	20	61	1955	25	153
1964	20	366	1956	25	366
1965	20	365	1957	25	365
1966	20	365	1958	25	365
1967	20	365	1959	25	365
1968	20	364	1960	25	366
1969	20	364	1961	25	365
1970	20	363	1962	25	363
1971	20	58	1963	25	365
1955	21	30	1964	25	366
1956	21	352	1965	25	350
1957	21	365	1966	25	363
1958	21	365	1967	25	362
1959	21	365	1968	25	364
1960	21	366	1969	25	365
1961	21	365	1970	25	359
1962	21	365	1971	25	353
1963	21	365	1955	26	30
1964	21	366	1956	26	366
1965	21	365	1957	26	365
1966	21	365	1958	26	364
1967	21	365	1959	26	364
1968	21	366	1960	26	353
1969	21	365	1961	26	365
1970	21	365	1962	26	362
1971	21	365	1963	26	365
1972	21	152	1964	26	365
1955	22	30	1965	26	356
1956	22	366	1966	26	359
1957	22	365	1967	26	74
1958	22	358	1955	27	30
1959	22	361	1956	27	366
1960	22	366	1957	27	351
1961	22	365	1958	27	358
1962	22	358	1959	27	365
1963	22	347	1960	27	366
1964	22	364	1961	27	365

Table XXIII. Continued

Year	Station	Number of Days	Year	Station	Number of Days
1962	27	365	1963	37	365
1963	27	365	1964	37	366
1964	27	366	1965	37	365
1965	27	365	1966	37	365
1966	27	344	1967	37	362
1967	27	365	1968	37	265
1968	27	366	1969	37	188
1969	27	351	1950	39	365
1970	27	355	1951	39	365
1955	28	101	1952	39	366
1956	28	359	1953	39	365
1957	28	183	1954	39	365
1958	28	353	1955	39	365
1959	28	163	1956	39	366
1955	29	151	1957	39	365
1956	29	256	1958	39	365
1957	29	334	1959	39	365
1958	29	363	1960	39	366
1959	29	362	1961	39	365
1960	29	104	1962	39	365
1961	29	122	1963	39	365
1955	30	21	1964	39	182
1956	30	197	1955	41	153
1955	31	30	1956	41	366
1956	31	345	1957	41	365
1957	31	365	1958	41	365
1958	31	90	1959	41	365
1955	32	30	1960	41	366
1956	32	366	1961	41	365
1957	32	337	1962	41	365
1958	32	319	1963	41	365
1959	32	45	1964	41	366
1955	34	30	1965	41	365
1956	34	366	1966	41	365
1957	34	335	1967	41	365
1958	34	267	1968	41	366
1959	34	365	1969	41	365
1960	34	366	1970	41	365
1961	34	365	1971	41	365
1962	34	365	1972	41	152
1963	34	358	1955	43	194
1964	34	366	1956	43	335
1965	34	365	1957	43	349
1966	34	365	1958	43	361
1967	34	365	1959	43	365
1968	34	366	1960	43	366
1969	34	365	1961	43	363
1970	34	361	1962	43	361
1955	35	30	1963	43	365
1956	35	355	1964	43	366
1955	36	21	1965	43	91
1956	36	116	1955	44	23
1955	37	30	1956	44	351
1956	37	366	1957	44	365
1957	37	365	1958	44	350
1958	37	365	1959	44	364
1959	37	264	1960	44	96
1960	37	366	1955	45	136
1961	37	365	1956	45	342
1962	37	365	1957	45	364

Table XXIII. Continued

Year	Station	Number of Days	Year	Station	Number of Days
1958	45	365	1959	56	365
1959	45	352	1960	56	245
1960	45	69	1961	56	301
1955	46	29	1955	59	30
1957	46	351	1956	59	314
1958	46	357	1957	59	354
1959	46	364	1958	59	310
1960	46	357	1959	59	81
1961	46	336	1955	60	135
1962	46	365	1956	60	346
1963	46	365	1957	60	336
1964	46	344	1958	60	357
1955	47	153	1959	60	365
1956	47	361	1960	60	340
1957	47	361	1961	60	344
1958	47	364	1962	60	67
1959	47	365	1955	61	30
1960	47	366	1956	61	365
1961	47	360	1957	61	365
1962	47	101	1958	61	365
1955	48	153	1959	61	364
1956	48	307	1960	61	305
1957	48	358	1961	61	306
1958	48	363	1962	61	365
1959	48	365	1963	61	365
1960	48	102	1964	61	366
1955	49	153	1965	61	365
1956	49	366	1966	61	365
1957	49	363	1967	61	365
1958	49	365	1968	61	365
1959	49	245	1969	61	365
1961	49	140	1970	61	365
1962	49	354	1971	61	365
1963	49	362	1972	61	152
1964	49	366	1955	63	30
1965	49	298	1956	63	359
1955	50	30	1957	63	358
1956	50	352	1958	63	358
1957	50	340	1959	63	365
1958	50	355	1960	63	366
1959	50	358	1961	63	358
1960	50	179	1962	63	365
1955	52	30	1963	63	365
1956	52	366	1964	63	359
1957	52	364	1965	63	365
1958	52	365	1966	63	351
1959	52	364	1967	63	365
1960	52	359	1968	63	359
1961	52	365	1969	63	351
1962	52	365	1970	63	358
1963	52	10	1955	64	30
1955	55	122	1956	64	365
1956	55	303	1957	64	363
1957	55	360	1958	64	365
1958	55	365	1959	64	364
1959	55	166	1960	64	305
1955	56	30	1955	65	28
1956	56	359	1956	65	336
1957	56	351	1957	65	290
1958	56	358	1960	65	242

Table XXIII. Continued

Year	Station	Number of Days	Year	Station	Number of Days
1961	65	363			
1962	65	334	1965	67	365
1963	65	244	1966	67	365
1964	65	60	1967	67	365
1967	65	231	1968	67	363
1968	65	366	1969	67	365
1969	65	357	1970	67	363
1970	65	364	1971	67	362
1955	66	26	1956	68	298
1956	66	364	1957	68	254
1957	66	344	1958	68	255
1958	66	365	1959	68	256
1959	66	362	1960	68	254
1960	66	366	1961	68	175
1961	66	363	1956	69	354
1962	66	363	1957	69	354
1963	66	364	1958	69	361
1964	66	362	1959	69	154
1965	66	349	1955	70	132
1966	66	345	1956	70	173
1967	66	300	1958	71	365
1968	66	360	1959	71	281
1969	66	354	1960	71	365
1970	66	357	1961	71	365
1956	67	364	1962	71	323
1957	67	364	1963	71	365
1958	67	365	1964	71	363
1959	67	364	1965	71	364
1960	67	366	1966	71	365
1961	67	365	1967	71	364
1962	67	359	1968	71	366
1963	67	365			
1964	67	347			

Table XXIV. Data on WINDTWO

Year	Station	Number of Days	Year	Station	Number of Days
0	0	0	1957	81	362
1969	71	21	1958	81	360
1970	71	365	1959	81	365
1962	72	192	1960	81	356
1961	74	312	1961	81	349
1962	74	305	1962	81	365
1956	75	162	1963	81	365
1957	75	350	1964	81	365
1958	75	364	1965	81	365
1959	75	365	1966	81	365
1960	75	364	1967	81	365
1961	75	285	1968	81	366
1962	75	306	1969	81	365
1963	75	364	1970	81	365
1964	75	366	1956	82	26
1965	75	365	1957	82	351
1966	75	365	1958	82	355
1967	75	365	1959	82	363
1968	75	366	1960	82	144
1969	75	365	1956	83	12
1970	75	365	1957	83	361
1971	75	365	1958	83	365
1972	75	152	1959	83	365
1956	76	365	1960	83	356
1957	76	365	1961	83	362
1958	76	151	1962	83	365
1955	77	28	1963	83	365
1956	77	361	1964	83	358
1957	77	365	1965	83	365
1958	77	365	1966	83	265
1959	77	365	1957	84	362
1960	77	366	1958	84	357
1961	77	81	1959	84	361
1955	78	30	1960	84	182
1956	78	150	1956	85	8
1956	79	171	1957	85	323
1957	79	353	1958	85	365
1958	79	360	1959	85	364
1959	79	365	1960	85	169
1960	79	180	1957	86	284
1956	80	27	1958	86	365
1957	80	365	1959	86	365
1958	80	351	1960	86	342
1959	80	344	1961	86	360
1960	80	270	1962	86	361
1961	80	188	1963	86	365
1962	80	344	1964	86	365
1963	80	365	1965	86	365
1964	80	366	1966	86	365
1965	80	355	1967	86	365
1966	80	356	1968	86	366
1967	80	351	1969	86	365
1968	80	358	1970	86	365
1969	80	337	1971	86	362
1970	80	361	1957	87	184
1956	81	14			

Table XXIV. Continued

Year	Station	Number of Days	Year	Station	Number of Days
1957	88	365	1967	95	364
1959	88	40	1968	95	366
1958	89	365	1969	95	365
1959	89	365	1970	95	365
1960	89	366	1960	97	275
1961	89	365	1961	97	351
1962	89	365	1962	97	362
1963	89	365	1963	97	361
1964	89	366	1964	97	366
1965	89	365	1965	97	365
1966	89	365	1966	97	360
1967	89	365	1967	97	365
1968	89	366	1968	97	366
1969	89	365	1969	97	365
1970	89	365	1970	97	365
1971	89	365	1971	97	365
1972	89	152	1960	98	335
1957	90	76	1961	98	365
1958	90	363	1962	98	365
1959	90	365	1963	98	365
1960	90	366	1964	98	366
1961	90	365	1965	98	365
1962	90	365	1966	98	365
1963	90	361	1967	98	318
1964	90	134	1968	98	366
1958	91	286	1969	98	365
1959	91	336	1970	98	365
1960	91	358	1971	98	365
1961	91	357	1960	99	153
1962	91	351	1961	99	364
1963	91	365	1962	99	350
1964	91	359	1963	99	327
1965	91	344	1964	99	365
1966	91	363	1965	99	365
1967	91	363	1966	99	365
1968	91	280	1967	99	363
1969	91	362	1968	99	364
1970	91	364	1969	99	357
1958	94	73	1970	99	362
1959	94	364	1962	100	279
1960	94	365	1963	100	360
1961	94	365	1964	100	365
1962	94	365	1965	100	365
1963	94	365	1966	100	365
1964	94	335	1967	100	361
1965	94	365	1968	100	362
1966	94	365	1969	100	363
1967	94	304	1970	100	365
1968	94	313	1971	100	364
1969	94	338	1962	101	69
1970	94	353	1963	101	362
1971	94	350	1964	101	366
1959	95	308	1965	101	365
1960	95	364	1966	101	365
1961	95	361	1967	101	365
1962	95	362	1968	101	350
1963	95	349	1969	101	364
1964	95	365	1970	101	365
1965	95	365	1962	102	54
1966	95	365	1963	102	362

Table XXIV. Continued

Year	Station	Number of Days	Year	Station	Number of Days
1964	102	364			
1965	102	363	1966	109	364
1966	102	365	1967	109	365
1967	102	365	1968	109	366
1968	102	366	1969	109	365
1969	102	365	1970	109	365
1970	102	336	1959	110	198
1963	103	257	1960	110	347
1964	103	361	1961	110	360
1965	103	362	1962	110	365
1966	103	351	1963	110	364
1967	103	362	1964	110	353
1968	103	297	1965	110	365
1969	103	363	1966	110	364
1970	103	365	1967	110	365
1963	104	35	1968	110	362
1964	104	366	1969	110	354
1965	104	363	1970	110	83
1966	104	365	1965	111	80
1967	104	365	1966	111	356
1968	104	366	1967	111	365
1969	104	364	1968	111	356
1970	104	365	1969	111	362
1964	105	253	1970	111	345
1965	105	362	1960	112	2
1966	105	352	1966	112	282
1967	105	243	1967	112	349
1965	106	358	1968	112	365
1966	106	365	1969	112	351
1967	106	365	1970	112	362
1968	106	366	1971	112	364
1969	106	365	1966	113	29
1970	106	365	1967	113	365
1965	107	233	1968	113	361
1966	107	365	1969	113	361
1967	107	362	1970	113	363
1968	107	366	1969	114	156
1969	107	365	1970	114	365
1970	107	365	1969	115	100
1961	108	1	1970	115	358
1965	108	232	1970	116	202
1966	108	365	1971	116	355
1967	108	365	1970	117	182
1968	108	366	1971	117	361
1969	108	352	1970	119	212
1970	108	362			
1965	109	204			

Table XXV. Data on WINDTHREE

Year	Station	Number of Days	Year	Station	Number of Days
0	0	0			
1971	2	363	1971	71	181
1972	2	350	1972	71	363
1973	2	352	1973	71	359
1971	5	363	1971	75	365
1972	5	365	1972	75	366
1973	5	344	1973	75	365
1971	12	321	1974	75	365
1972	12	364	1971	80	362
1973	12	349	1972	80	224
1971	13	365	1971	81	365
1972	13	366	1972	81	364
1973	13	365	1973	81	363
1974	13	365	1971	86	362
1971	14	365	1972	86	366
1972	14	363	1971	89	365
1973	14	351	1972	89	366
1971	20	58	1973	89	364
1971	21	365	1974	89	120
1972	21	366	1971	91	224
1973	21	365	1973	91	7
1974	21	365	1971	94	350
1971	22	362	1972	94	361
1972	22	365	1973	94	344
1973	22	352	1972	95	323
1971	25	355	1973	95	301
1971	27	356	1971	97	365
1972	27	359	1972	97	360
1973	27	359	1973	97	365
1974	27	69	1971	98	365
1971	34	365	1972	98	365
1972	34	365	1973	98	288
1973	34	365	1971	99	173
1971	41	365	1972	99	361
1972	41	366	1973	99	362
1973	41	365	1971	100	364
1974	41	365	1972	100	365
1971	61	365	1973	100	349
1972	61	366	1971	101	335
1973	61	365	1972	101	361
1974	61	365	1973	101	350
1971	63	340	1971	102	360
1972	63	308	1972	102	363
1973	63	337	1973	102	359
1971	65	181	1971	103	365
1972	65	31	1972	103	243
1971	66	332	1973	103	357
1972	66	357	1971	104	365
1971	67	363	1972	104	326
1972	67	326	1973	104	242
1973	67	300	1971	106	365

Table XXV. Continued

Year	Station	Number of Days
1972	106	366
1973	106	228
1971	107	365
1972	107	366
1973	107	243
1971	108	365
1972	108	366
1973	108	167
1971	109	365
1972	109	366
1973	109	334
1971	111	205
1971	112	364
1972	112	363
1973	112	227
1971	113	360
1972	113	366
1973	113	320
1971	114	365
1972	114	366
1973	114	243
1971	115	365
1972	115	367
1973	115	365
1971	116	355
1972	116	130
1971	117	361
1972	117	366
1973	117	334
1971	119	295
1972	119	347
1973	119	162
1971	120	139
1972	120	366
1973	120	225
1972	121	341
1973	121	7
1972	122	221
1973	122	361
1972	126	332
1973	126	362
1973	128	360

Table XXVI. Data on UPPERAIR

	Year	# Days with Obs	Obs
El Monte* L0090	1972	251	502
	1973	250	501
Los Angeles L0100	1972	366	732
	1973	365	721
Vandenberg AFB 93214	1972	366	613
	1973	365	727

*El Monte collects data on weekdays only.

CHAPTER VI

SAMPLE PROGRAMS

INTRODUCTION

Throughout this project a great number of programs have been developed to access the data on the original tapes and to manipulate these data. Some sample programs are presented here, including one program to access each type of data tape and typical programs which use the data. Unless otherwise noted, these programs are written in Algol to run on the UCSD Burroughs 6700. Therefore they are not directly transferable to most other systems, but are presented here to give some idea of how such programs can be constructed.

PROGRAM TO ACCESS LAAPCD POLLUTANT DATA TAPES

This program reads the original data in the format supplied by the LAAPCD, finds the daily average and daily hourly maximum for each day, and saves these in two separate files, one for the averages and one for the maxima. Each run for a specific pollutant will access as many stations as are indicated.

```
BEGIN

FILE DST(KIND=DISK, MAXRECSIZE=375, BLOCKSIZE=750, TITLE="ALL/OX.");          1

FILE SAVESUM(KIND=DISK, MAXRECSIZE=300, BLOCKSIZE=300,
         AREASIZE=2, AREAS=10, FLEXIBLE=TRUE, PROTECTION=SAVE,
         SECURITYTYPE=CLASSA,
         TITLE="AVERAGES/CO.");

FILE SAVEMAX(KIND=DISK, MAXRECSIZE=300, BLOCKSIZE=300,
         AREASIZE=2, AREAS=10, FLEXIBLE=TRUE, PROTECTION=SAVE,
         SECURITYTYPE=CLASSA,
         TITLE="MAXIMUM/CO.");

FILE READER(KIND=READER);

FILE PRINTER(KIND=PRINTER, MAXRECSIZE=22);

FILE PUNCHER(KIND=PUNCH, MAXRECSIZE=14);

ARRAY DATA[0:375], DATAHR[1:24], SUM[0:3000], MAX[0:3000], DUMMY[1:24];
LABEL FINISH, NEXTREC, ENTERLOOP, NODATA, NODAY, NEXTSTA, AVERAGE,
         BEGINLOOP, INITIALIZE, NEXTDAY;
POINTER PDATA, PDUM;
INTEGER STA, STATION, STAT, DAY, HR, MONTH, NODAYS, MODAYS, ROW, YEAR,
         YEARDAY, DAYOFWEEK, DAYS, K, POLLUTANT, POL, RECORDS,
         FIRSTTIME, MAXIMUM, WEEK, HRS, YEARS, DIFF;
REAL AVG;
VALUE ARRAY MISSING(0,1,1,1,1,1, 60, 152, 32, 1309, 1674, 1734, 1248);

VALUE ARRAY PLACE(0, 1, 60, 69, 71, 72, 74, 75, 76, 79, 80, 81, 299,99);

VALUE ARRAY END(0,365,730,731,1096,1461,1826,2191,2192,2557,2992);


WHILE TRUE DO
   BEGIN
   READ(DST, 375, DATA[*])[AVERAGE];
   PDATA:= POINTER(DATA) + 1;                                                 2
   IF PDATA EQL "015" THEN GO TO INITIALIZE;
   END;
INITIALIZE:
POLLUTANT:=15;                                                                2

FOR STA:=1 STEP 1 UNTIL 10 DO
   BEGIN
   FIRSTTIME:=1;
   RECORDS:=1;                                                                2

NEXTREC:
   PDATA:= POINTER(DATA) + 1;
   POL:= INTEGER(PDATA,3);
```

```
   IF POLLUTANT LSS POL THEN GO TO AVERAGE;
   PDATA:= PDATA + 3;
   STATION:= INTEG_R(PDATA,3);
   IF STATION NEQ PLACE[STA] THEN GO TO AVERAGE;
   PDATA:= PDATA + 4;
   YEAR:= INTEGER(PDATA,4);
   PDATA:= PDATA + 4;
   MONTH:= INTEGER(PDATA,2);
   ROW:= ((MONTH-1) DIV 3);
   PDATA:= PDATA + 2;
   NODAYS:= INTEGER(PDATA,2);
   MODAYS:=0;
   PDATA:= PDATA + 2;

IF FIRSTTIME EQL 1 THEN
   BEGIN
   FIRSTTIME:=0;                                                      3
   GO TO BEGINLOOP;
   END
ELSE GO TO ENTERLOOP;                                                 3

BEGINLOOP:
FOR YEARDAY:= MISSING[STA] STEP 1 UNTIL 2922 DO
   BEGIN
ENTERLOOP:                                                            3
   MODAYS:= * + 1;
   IF MODAYS GTR NODAYS THEN
      BEGIN
      READ(DST,375,DATA[*])[AVERAGE];                                 4
      RECORDS:= * + 1;
      GO TO NEXTREC;
      END;
                                                                      4
PDUM:= POINTER(DUMMY);
REPLACE PDUM BY PDATA FOR 72;
PDATA:= PDATA + 72;
READ(DUMMY[*], <24I3>, FOR HR:=1 STEP 1 UNTIL 24 DO DATAHR[HR]);
AVG:=0;
HRS:=0;
MAXIMUM:=0;
FOR HR:=1 STEP 1 UNTIL 24 DO
   BEGIN
   IF DATAHR[HR] LSS 0 THEN GO TO NODATA;                             4
   DATAHR[5]:= (DATAHR[4] + DATAHR[6])/2;
   IF DATAHR[HR] GTR MAXIMUM THEN MAXIMUM:= DATAHR[HR];
   AVG:= * + DATAHR[HR];
   HRS:= * + 1;
NODATA: END;
                                                                      4
IF AVG EQL 0 OR HRS EQL 0 THEN GO TO NEXTDAY ELSE
   BEGIN
   MAX[YEARDAY]:= MAXIMUM;                                            4
   SUM[YEARDAY]:= AVG/HRS;
   END;
                                                                      4
NEXTDAY: END;                  %%%%%      END OF YEAR LOOP
                                                                      3
AVERAGE:
IF STATION EQL PLACE[STA] THEN
   BEGIN
```

```
   READ(DST, 375, DATA[*])[NEXTSTA];                                        3
   RECORDS:= * + 1;
   END;
WRITE(PRINTER, <"TOTAL RECORDS READ", I6>, RECORDS);                        3

FOR DAY:=1 STEP 300 UNTIL 2800 DO
BEGIN
WRITE(SAVESUM, <300F6.2>, FOR K:= DAY STEP 1 UNTIL (DAY+299) DO             3
         SUM[K]);
WRITE(SAVEMAX, <300F6.2>, FOR K:= DAY STEP 1 UNTIL (DAY+299) DO
         MAX[K]);
END;
NEXTSTA: END;                  %%%%%    END OF STATION LOOP                 3
                                                                            2
FINISH:
END.
```

PROGRAM TO CALCULATE WEEKLY VARIATIONS

This program uses the average and maximum files created by the previous program to calculate the mean value for each day of the week with its standard deviation. It runs for any number of years and for as many stations as specified. A separate run is necessary for each pollutant.

```
BEGIN

FILE READER(KIND=READER);                                                    1

FILE PRINTER(KIND=PRINTER);

FILE OXDATA(KIND=DISK, MAXRECSIZE=300, BLOCKSIZE=300,
          TITLE="AVERAGES/NO.");

ARRAY SUM[0:7], SQUARES[0:7], STDEV[0:7], DATA[0:3000], SIGMA[0:10],
          HRS[0:7], AVG[0:7];
ARRAY WEEKS2[0:7], SUMDIFFS[0:7];
INTEGER DAY, YEARDAY, STA, D, I, NUMBERYEARS, COUNTER, WEEKS, W;
INTEGER TRIAL, DAYX, ENDS;
REAL DIFF, SUMDIFF, SQUARE;
LABEL NEXTYEAR1, NEXTYEAR2, NOWEEK, NOTUESDAY;
VALUE ARRAY PLACE(0, 1, 60, 69, 71, 72, 74, 75, 76, 79, 80);

VALUE ARRAY DAYS(0, 2557, 2192, 1827, 1462, 1095, 731, 366, 1);


%%%%%     GET THE DATA AND INITIAL PRINT STATEMENTS

FOR STA:=1 STEP 1 UNTIL 10 DO
   BEGIN
FOR DAY:=1 STEP 300 UNTIL 2800 DO                                            2
   READ(OXDATA, <300F6.2>,FOR D:=DAY STEP 1 UNTIL (DAY+299) DO DATA[D]);
WRITE(PRINTER[SKIP 1]);
WRITE(PRINTER, <X55, "STATION", I3>, PLACE[STA]);
WRITE(PRINTER,/,);
WRITE(PRINTER, <X53, "NO -- AVERAGES">);
WRITE(PRINTER,/,);
WRITE(PRINTER, <X55, "ENTIRE YEAR">);
WRITE(PRINTER, <///>);


%%%%%     THIS PART CALCULATES WEEKEND AND WEEKDAY AVERAGES
%%%%%     AND THE STANDARD DEVIATION OF THE DIFFERENCE

WRITE(PRINTER, <X3, "YEARS", X20, "WEEKENDS", X32, "WEEKDAYS", X21,
          "S2 OF DIFF", X10, "DIFF">);

WRITE(PRINTER,/,);
WRITE(PRINTER, <X18, "AVERAGE", X15, "STDEV", X13, "AVERAGE", X15,
          "STDEV">);

   WRITE(PRINTER, <//>);

%%%%%     THE PROGRAM RUNS FOR ONE TO EIGHT YEARS, 1965-1972

FOR NUMBERYEARS:=1 STEP 1 UNTIL 8 DO
   BEGIN
```

```
FOR DAY:=1 STEP 1 UNTIL 2 DO                                          3
   BEGIN
   SUM[DAY]:=0;                                                        4
   SQUARES[DAY]:=0;
   HRS[DAY]:=0;
   AVG[DAY]:=0;
   END;

FOR YEARDAY:= DAYS[NUMBERYEARS] STEP 1 UNTIL 2920 DO                  4
   BEGIN
   DAY:= ((YEARDAY-2) MOD 7) + 1;                                      4
   IF DAY LEQ 2 THEN D:=1 ELSE D:=2;
   IF DATA[YEARDAY] NEQ 0 THEN
      BEGIN
      SUM[D]:= * + DATA[YEARDAY];                                      5
      SQUARES[D]:= * + (DATA[YEARDAY]**2);
      HRS[D]:= * + 1;
      END;
   END;                                                                5

FOR DAY:=1 STEP 1 UNTIL 2 DO                                          4
   BEGIN
   IF HRS[DAY] EQL 0 THEN HRS[DAY]:=1;                                 4
   AVG[DAY]:= SUM[DAY]/HRS[DAY];
   STDEV[DAY]:= (SQUARES[DAY] - ((SUM[DAY]**2)/HRS[DAY]))/HRS[DAY];
   END;

   DIFF:= AVG[1] - AVG[2];                                             4
   SIGMA[STA]:= ((STDEV[1]/HRS[1]) + (STDEV[2]/HRS[2]))**.5;
   STDEV[1]:= STDEV[1]**.5;
   STDEV[2]:= STDEV[2]**.5;

WRITE(PRINTER, <I6, X13, F6.3, X15, F5.3, X14, F6.3, X15, F5.3, X14,
          F6.4, X11, F6.3>, NUMBERYEARS, AVG[1], STDEV[1], AVG[2],

          STDEV[2], SIGMA[STA], DIFF);
WRITE(PRINTER,/,);
NEXTYEAR1: END;                  %%%%%     END OF 8 YEAR LOOP

%%%%%     THIS HALF CALCULATES AVERAGES AND STANDARD DEVIATIONS      3
%%%%%     FOR EACH DAY OF THE WEEK

WRITE(PRINTER, <////>);
WRITE(PRINTER, <" YEARS     SAT      DEV      SUN      DEV      MON      DEV
   TUE      DEV      WED      DEV      THU      DEV      FRI      DEV">);

WRITE(PRINTER, <//>);

%%%%%     THE PROGRAM RUNS FOR ONE TO EIGHT YEARS, 1965-1972

FOR NUMBERYEARS:=1 STEP 1 UNTIL 8 DO
   BEGIN

FOR DAY:=1 STEP 1 UNTIL 7 DO                                          3
   BEGIN
   SUM[DAY]:=0;                                                        4
   SQUARES[DAY]:=0;
   HRS[DAY]:=0;
   AVG[DAY]:=0;
```

```
   END;
                                                                     4
FOR YEARDAY:= DAYS[NUMBERYEARS] STEP 1 UNTIL 2920 DO
   BEGIN
                                                                     4
   D:= ((YEARDAY-2) MOD 7) + 1;
   IF DATA[YEARDAY] NEQ 0 THEN
      BEGIN
      SUM[D]:= * + DATA[YEARDAY];                                    5
      SQUARES[D]:= * + (DATA[YEARDAY]**2);
      HRS[D]:= * + 1;
      END;
   END;                                                              5
                                                                     4
FOR DAY:=1 STEP 1 UNTIL 7 DO
   BEGIN
   IF HRS[DAY] EQL 0 THEN HRS[DAY]:=1;                               4
   AVG[DAY]:= SUM[DAY]/HRS[DAY];
   STDEV[DAY]:= (SQUARES[DAY] - ((SUM[DAY]**2)/HRS[DAY]))/HRS[DAY]:
   STDEV[DAY]:= (STDEV[DAY]/HRS[DAY])**.5;
   END;
                                                                     4
WRITE(PRINTER, <I4,X2,7(X3,F5.2,X3,F5.3)>, NUMBERYEARS, FOR DAY:=1 STEP
         1 UNTIL 7 DO [AVG[DAY], STDEV[DAY]]);
WRITE(PRINTER,/,);
NEXTYEAR2: END;                %%%%%      END OF 8 YEAR LOOP
   END;                        %%%%%      END OF STATION LOOP        3
END.                                                                 2
```

PROGRAM TO CALCULATE MEDIAN FRACTIONAL CHANGE BETWEEN WEEKDAYS AND WEEKENDS

This program uses the data files created by the first program to find the fractional differences: (Weekday-Weekend)/Weekday for the weekday and weekend averages (or maxima) week by week. These data are then sorted to find the median value and the 95% confidence interval for the median. The program will run for any number of years for any number of stations. A separate run is required for each pollutant.

```
BEGIN

%%%%%     TO FIND THE % DIFFERENCES (WEEKDAY-WEEKEND)/WEEKDAY                1
%%%%%     FOR WEEKDAY AND WEEKEND AVERAGES WEEK BY WEEK, AND FOR
%%%%%     INDIVIDUAL DAYS (I.E. (TUES-SUN)/TUES)
%%%%%     THE PROGRAM RUNS FOR ONE TO EIGHT YEARS, 1965-1972
%%%%%     SATURDAY IS DAY 1, SUNDAY DAY 2, ETC.

FILE READER(KIND=READER);

FILE PRINTER(KIND=PRINTER);

FILE OXDATA(KIND=DISK, MAXRECSIZE=300, BLOCKSIZE=300,
          TITLE="MAXIMUM/NO.");

ARRAY SUM[0:7], SQUARES[0:7], STDEV[0:7], DATA[0:3000], SIGMA[0:10],
          HRS[0:7], AVG[0:7], TOSORT[0:4,0:420], K[0:4], UPPER[0:4],
          LOWER[0:4], MEDIAN[0:4];
ARRAY WEEKS2[0:7]; SUMDIFFS[0:7];
INTEGER DAY, YEARDAY, STA, D, I, NUMBERYEARS, COUNTER, WEEKS, W;
INTEGER TRIAL, DAYX, ENDS;
REAL DIFF, SUMDIFF, SQUARE;
LABEL NEXTYEAR1, NEXTYEAR2, NOWEEK, NOTUESDAY;
VALUE ARRAY PLACE(0, 1, 60, 69, 71, 72, 74, 75, 76, 79, 80);

VALUE ARRAY DAYS(0, 2557, 2192, 1827, 1462, 1095, 731, 366, 1);


%%%%%     GET THE DATA AND INITIAL PRINT STATEMENTS

FOR STA:=1 STEP 1 UNTIL 10 DO
   BEGIN
FOR DAY:=1 STEP 300 UNTIL 2800 DO
   READ(OXDATA, <300F6.2>,FOR D:=DAY STEP 1 UNTIL (DAY+299) DO DATA[D]);   2
WRITE(PRINTER[SKIP 1]);
WRITE(PRINTER, <X55, "STATION", I3>, PLACE[STA]);
WRITE(PRINTER,/,);
WRITE(PRINTER, <X53, "NO -- MAXIMA">);
WRITE(PRINTER,/,);
WRITE(PRINTER, <X55, "ENTIRE YEAR">);
WRITE(PRINTER, <///>);


%%%%%     THIS PART CALCULATES WEEKEND AND WEEKDAY AVERAGES
%%%%%     AND THE STANDARD DEVIATION OF THE DIFFERENCE

WRITE(PRINTER, <X3, "YEARS", X10, " LOWER", X12, "MEDIAN", X12, "UPPER">
        );

   WRITE(PRINTER, <//>);
```

```
FOR NUMBERYEARS:=1 STEP 1 UNTIL 8 DO
   BEGIN
   FOR TRIAL:=1 STEP 1 UNTIL 4 DO FOR WEEKS:=1 STEP 1 UNTIL 400 DO          3
      TOSORT[TRIAL,WEEKS]:=0;
   SUMDIFF:=0;
   WEEKS:=0;

FOR DAY:=1 STEP 1 UNTIL 2 DO
   BEGIN
   SUM[DAY]:=0;                                                              4
   SQUARES[DAY]:=0;
   HRS[DAY]:=0;
   AVG[DAY]:=0;
   END;
                                                                             4
FOR YEARDAY:= DAYS[NUMBERYEARS] STEP 1 UNTIL 2920 DO
   BEGIN
   DAY:= ((YEARDAY-2) MOD 7) + 1;                                            4
   IF DAY LEQ 2 THEN D:=1 ELSE D:=2;
   IF DATA[YEARDAY] NEQ 0 THEN
      BEGIN
      SUM[D]:= * + DATA[YEARDAY];                                            5
      HRS[D]:= * + 1;
      END;
      IF DAY EQL 7 THEN                                                      5
         BEGIN
         FOR W:=1 STEP 1 UNTIL 2 DO IF HRS[W] NEQ 0 THEN                     5
            SUM[W]:= */HRS[W] ELSE GO TO NOWEEK;
         WEEKS:= * + 1;
         TOSORT[1, WEEKS]:= (SUM[2]-SUM[1])/SUM[2];
         NOWEEK:
         SUM[1]:=0;
         SUM[2]:=0;
         HRS[1]:=0;
         HRS[2]:=0;
         END;
   END;                                                                      5
                                                                             4
   IF WEEKS EQL 0 THEN WEEKS:=1;
   K[1]:= (WEEKS-(1.64*(WEEKS**.5)))/2;
   SORTNM(TOSORT[1,*], 1, WEEKS);
   LOWER[1]:= TOSORT[1, K[1]];
   MEDIAN[1]:= TOSORT[1, (1+WEEKS)/2];
   UPPER[1]:= TOSORT[1, WEEKS-K[1]+1];


WRITE(PRINTER, <I6,3F18.4>, NUMBERYEARS, LOWER[1], MEDIAN[1], UPPER[1]);
WRITE(PRINTER,/,);
NEXTYEAR1: END;                  %%%%%      END OF 8 YEAR LOOP
                                                                             3
%%%%%      THIS HALF CALCULATES AVERAGES AND STANDARD DEVIATIONS
%%%%%      FOR EACH DAY OF THE WEEK

WRITE(PRINTER, <////>);
WRITE(PRINTER, <X13, "T-SA", X26, "W-SA", X26, "T-SU", X26, "W-SU">);

WRITE(PRINTER,/,);
WRITE(PRINTER, <X1, 4(X3, " LOWER", X4, "MEDIAN", X4, "UPPER ")>);

WRITE(PRINTER, <//>);
```

```
FOR NUMBERYEARS:=1 STEP 1 UNTIL 8 DO
   BEGIN
                                                                        3
   FOR TRIAL:=1 STEP 1 UNTIL 4 DO
      BEGIN
      FOR WEEKS:=1 STEP 1 UNTIL 400 DO TOSORT[TRIAL, WEEKS]:=0;         4
      WEEKS2[TRIAL]:=0;
      END;
                                                                        4
FOR YEARDAY:= DAYS[NUMBERYEARS] STEP 1 UNTIL 2920 DO
   BEGIN
                                                                        4
   D:= ((YEARDAY-2) MOD 7) + 1;
   SUM[D]:= DATA[YEARDAY];
   IF D EQL 7 THEN
      BEGIN
      FOR ENDS:=1 STEP 1 UNTIL 2 DO                                     5
      FOR DAYX:=4 STEP 1 UNTIL 5 DO
         BEGIN
         TRIAL:= (DAYX-5)+(ENDS*2);                                     6
         IF SUM[DAYX] NEQ 0 AND SUM[ENDS] NEQ 0 THEN
            BEGIN
            WEEKS2[TRIAL]:= * + 1;                                      7
            TOSORT[TRIAL, WEEKS2[TRIAL]]:= (SUM[DAYX]-SUM[ENDS])/
               SUM[DAYX];
            END;
         END;                                                           7
      END;                                                              6
   END;                                                                 5
                                                                        4
   FOR TRIAL:=1 STEP 1 UNTIL 4 DO
      BEGIN
      IF WEEKS2[TRIAL] EQL 0 THEN WEEKS2[TRIAL]:=1;                     4
      K[TRIAL]:= (WEEKS2[TRIAL]-(1.64*(WEEKS2[TRIAL]**.5)))/2;
      SORTNM(TOSORT[TRIAL,*], 1, WEEKS2[TRIAL]);
      MEDIAN[TRIAL]:= TOSORT[TRIAL, (1+WEEKS2[TRIAL])/2];
      UPPER[TRIAL]:= TOSORT[TRIAL, WEEKS2[TRIAL]-K[TRIAL]+1];
      LOWER[TRIAL]:= TOSORT[TRIAL, K[TRIAL]];
      END;
                                                                        4
WRITE(PRINTER, <12F10.4>, FOR TRIAL:=1 STEP 1 UNTIL 4 DO
       [LOWER[TRIAL], MEDIAN[TRIAL], UPPER[TRIAL]]);
WRITE(PRINTER,/,);
NEXTYEAR2: END;                  %%%%     END OF 8 YEAR LOOP
   END;                          %%%%     END OF STATION LOOP           3
END.                                                                    2
```

PROGRAM TO ACCESS CARB TAPES

This program takes the original data in the format supplied by the California Air Resources Board, finds the daily average and maximum for each day and saves these in separate files, one for each station. It will run for as many stations as are requested and for any number of pollutants.

```
BEGIN

FILE
  CARB(KIND=TAPE9,MAXRECSIZE=20,BLOCKSIZE=600),                                    1

  DOXMOX(KIND=DISK,MAXRECSIZE=3,BLOCKSIZE=450,AREASIZE=360,AREAS=7,
    SECURITYTYPE=CLASSA,LABELTYPE=OMITTEDEOF),

%  DISKCARB(KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=10,FLEXIBLE).
  YEARFILE(KIND=DISK,FILETYPE=7),

  P(KIND=PRINTER);

 LABEL MISSINGSTATION;
POINTER PP,TP,YP,SP,DP;
ARRAY CHK,AVE,MAX[0:370],PARRAY[0:1],BUFF[0:20],TABLE[0:1,0:12],
  SKIPNUM[0:7];
INTEGER ST,MA,AV,T,I,FIRSTREC,YEAR,MON,DAY,STA,STATION,BLA,DAYOFYEAR,
   RECCOUNT,DAYCHECK,DISKTEMP,AVECNT,MAXCNT, EMPTY, AVERAGECOUNT, POL;
PROCEDURE FIXUP(AVE,RECCOUNT);
  INTEGER RECCOUNT;
  ARRAY AVE[0];
  BEGIN
  INTEGER MISSING1,MISSING2,ZEROS,T,I,MISSINGFIRST,BIGZEROS;

BOOLEAN FIXED;
REAL AVERAGE;                                                                      2
  IF AVE[1] = 0
    THEN
      BEGIN
      WHILE AVE[T:=*+1] = 0 AND T<362  DO;
      FOR EMPTY:=1 STEP 1 UNTIL T-1 DO AVE[EMPTY]:= AVE[T];                        3
      END
    ELSE
      T:=1;                                                                        3
  FOR I:=T+1 STEP 1 UNTIL 360 DO
    IF AVE[I]=0
      THEN
        ZEROS:=*+1
      ELSE
        CASE IF ZEROS>2 THEN 3 ELSE ZEROS OF
        BEGIN
        0:;
        1:AVE[I-1]:=(AVE[I]+AVE[I-2])/2;                                           3
          MISSING1:=*+1;
          ZEROS:=0;
        2:AVE[I-2]:=(AVE[I]+AVE[I-3])/2;
          AVE[I-1]:=AVE[I-2];
          MISSING2:=*+1;
          ZEROS:=0;
         3:  AVERAGECOUNT:=0;
             AVERAGE:=0;
```

```
            FOR T:=I STEP 1 UNTIL I+ZEROS-1
               ,I-ZEROS-1 STEP -1 UNTIL I-2*ZEROS DO
               IF T LEQ 360 AND T GEQ 1 THEN IF AVE[T] NEQ 0 THEN
                 BEGIN
                 AVERAGE:= * + AVE[T];                                        4
                 AVERAGECOUNT:= * + 1;
                 END;
          AVERAGE:= AVERAGE/AVERAGECOUNT;                                     4
            FOR T:=I-ZEROS STEP 1 UNTIL I-1 DO
              AVE[T]:=AVERAGE;
          WRITE(P, <"THERE ARE "I3 " ZEROS"," STARTING AT "I3" ("I4")">,
            ZEROS, I-ZEROS, I-ZEROS+FIRSTREC);
          BIGZEROS:=*+ZEROS;
          ZEROS:=0
        END;
  FOR EMPTY:=360-ZEROS STEP 1 UNTIL 360 DO AVE[EMPTY]:=AVE[360-ZEROS-1];    3
  IF ZEROS ISNT 0 THEN WRITE(P,<"LAST "I3" ARE ZERO">,ZEROS);
    WRITE(P,<"MISSING 1 & 2 ARE:" I3,X1,I3, ", BIGZEROS= "I3>,

      MISSING1,MISSING2,BIGZEROS) ;
  IF (T:=MISSING1+MISSINGFIRST+BIGZEROS+ZEROS+2*MISSING2+RECCOUNT)=360
    THEN WRITE(P,<"ALL RECORDS ACOUNTED FOR">)
    ELSE WRITE(P,<" ONLY "I3 " OF 360 RECORDS ACOUNTED FOR. ***********">
            ,T);

  END;

AVE[0]:=0;                                                                  2
FILL TABLE[0,*] WITH 0,0,31,29,31,30,31,30,31,31,30,31,30;
FILL TABLE[1,*] WITH 0,0,31,28,31,30,31,30,31,31,30,31,30;
FOR T:=0 STEP 1 UNTIL 1 DO
  FOR I:=1 STEP 1 UNTIL 12 DO
    TABLE[T,I]:=TABLE[T,I]+TABLE[T,I-1];
FILL SKIPNUM[*] WITH 2,1,0,5,4,3,2,0;
 AVE[361]:=999999;
SP:=POINTER(BUFF)+3;
DP:=POINTER(BUFF)+9;
TP:=POINTER(BUFF)+5;
% GO TO VARIABLE 12
FOR POL:= 15, 21, 23 DO
  BEGIN
  WHILE INTEGER(TP,2) NEQ POL DO                                            2
  READ(CARB,20,BUFF);
 YP:=POINTER(PARRAY);
READ(BUFF,<X7,I2>,YEAR);
REPLACE YP BY "DOXMOX  .";
REPLACE YP+6 BY YEAR FOR 2 DIGITS;
REPLACE DOXMOX.TITLE BY YP;
%WRITE(P,<"THIS RUN GENERATES "A8>,YP);
FOR STATION:= 33126, 36151, 36165 DO
  BEGIN
    DAYCHECK:=AVECNT:=MAXCNT:=RECCOUNT:=0;                                  3
    WRITE(P[SKIP 1]);
    REPLACE POINTER(AVE) BY 0 FOR 361 WORDS;
    REPLACE POINTER(MAX) BY 0 FOR 361 WORDS;
    REPLACE POINTER(CHK) BY "      " FOR 361 WORDS;
  REPLACE YP BY STATION FOR 5 DIGITS;
  PP:=POINTER(BUFF);
   WHILE YP GTR PP FOR 5 DO
    READ(CARB,20,BUFF);
```

```
IF YP NEQ PP FOR 5 THEN
  BEGIN
  WRITE(P,<"STATION# "I5" IS MISSING">,STATION);
    REPLACE POINTER(AVE[*]) BY 999999 FOR 361 WORDS;                  4
    REPLACE POINTER(MAX[*]) BY 999999 FOR 361 WORDS;
    WRITE(P,20,BUFF);
  GO MISSINGSTATION
  END;
THRU SKIPNUM[YEAR-66] DO
  READ(CARB,20,BUFF);                                                 4
WRITE(P,<"PROCESSING STATION # "I5", STARTING AT "I4", FOR "I4///>,

         STATION,FIRSTREC,YEAR+1900);
WRITE(P,20,BUFF);
READ(BUFF,<I5,X4,I2,I2,X77,I3,F4.1,X4,I1>,
  STA,MON,DAY,MA,AV,BLA);
DO
  BEGIN
%  IF DISKTEMP:=*+1<370 THEN WRITE(DISKCARB,20,BUFF);                 4
  DAYOFYEAR:=DAY+TABLE[IF YEAR=72 OR YEAR=68 THEN 0 ELSE 1,MON]
    -SKIPNUM[YEAR-66];
  IF DAYCHECK:=*+1 ISNT DAYOFYEAR THEN
    WRITE(P,<"DAYOFYEAR ERROR, DAYCHECK="I3":="I3>,

      DAYCHECK,DAYCHECK:=DAYOFYEAR);
  IF DAYOFYEAR=355 THEN
    BEGIN
     WRITE(P,<"DAY 355("I4")">,355+FIRSTREC);                         5
    WRITE(P,20,BUFF);
    END;
  IF BLA IS 1 AND DAYOFYEAR<361  THEN                                 5
    BEGIN
    RECCOUNT:=*+1;
    REPLACE POINTER(CHK[DAYOFYEAR])BY SP FOR 2,DP FOR 4;              5
  IF AV NEQ 0 THEN
    BEGIN
    AVE[DAYOFYEAR]:=AV;
    AVECNT:=*+1;                                                      6
    END;
  IF MA NEQ 0 THEN
    BEGIN                                                             6
    MAX[DAYOFYEAR]:=MA;
    MAXCNT:=*+1;                                                      6
    END;
    END;
  READ(CARB,20,BUFF);                                                 6
  READ(BUFF,<I5,X4,I2,I2,X77,I3,F4.1,X4,I1>,                          5
    STA,MON,DAY,MA,AV,BLA);
  END
 UNTIL STA ISNT STATION;
WRITE(P,<I3" DAYS HAD VALID DATA ("I3","I3")">,                       4

 RECCOUNT,AVECNT,MAXCNT);
WRITE(P,<////"FIXUP FOR STATION# "I5//"AVERAGE:">,STATION);

FIXUP(AVE,AVECNT);
WRITE(P,<//"MAXIMUM:">);
FIXUP(MAX,MAXCNT);
 MISSINGSTATION:
  WRITE(DOXMOX,<2F6.2,A6>,FOR T:=1 STEP 1 UNTIL 360 DO
```

```
    [AVE[T],MAX[T],CHK[T]]);
  FIRSTREC:=*+360;
  END;
  END;      %%%%%      END OF POLLUTANT LOOP
%LOCK(DISKCARB,CRUNCH);                                  3
LOCK(DOXMOX,CRUNCH);                                     2
END.
```

PROGRAM TO ACCESS THE LAAPCD WIND TAPES

This program uses LAAPCD wind data in the original format. It finds the 9:00-14:00 average wind speed in each of eight directions for each day, as well as the daily sum of wind speeds for all directions. The program may be run for any number of stations for any number of years.

```
BEGIN

FILE WIND(KIND=DISK, MAXRECSIZE=20, BLOCKSIZE=300, TITLE="WIND1973.");          1

FILE PRINTER(KIND=PRINTER);

FILE AVGWIND(KIND=DISK, MAXRECSIZE=365, BLOCKSIZE=365, TITLE="WIND6.",
          AREASIZE=2, AREAS=10, FLEXIBLE=TRUE, PROTECTION=SAVE);

INTEGER STA, STAT, HR, DAY, RECORDS, YEAR, MONTH, MODAY, D, POLLUTANT;
INTEGER DIR;
ARRAY DATA[0:20], DATAHR[0:24], SPEED[0:366,0:8], DIREC[0:24];
POINTER PDATA;
LABEL NODATA, BEGINLOOP, FINISH;

VALUE ARRAY PLACE(0, 13, 75, 97, 100, 101, 102, 107, 109, 114, 122);

VALUE ARRAY DAYS(0,0,31,59,90,120,151,181,212,243,273,304,334);


STA:=6;
RECORDS:=1;
POLLUTANT:=99;
DAY:=0;
WHILE TRUE DO
   BEGIN
   READ(WIND, 20, DATA[*])[FINISH];                                              2
   PDATA:= POINTER(DATA);
   STAT:= INTEGER(PDATA,3);
   IF STAT EQL PLACE[STA] THEN GO TO BEGINLOOP;
   END;
                                                                                 2
FOR DAY:=1 STEP 1 UNTIL 365 DO
FOR DIR:=1 STEP 1 UNTIL 8 DO
   SPEED[DAY,DIR]:=0;

BEGINLOOP:
WHILE TRUE DO
   BEGIN
   IF DAY NEQ 0 THEN                                                             2
      BEGIN
      READ(WIND, 20, DATA[*])[FINISH];                                           3
      RECORDS:= * + 1;
      END;
   PDATA:= POINTER(DATA);                                                        3
   STAT:= INTEGER(PDATA,3);
   IF STAT NEQ PLACE[STA] THEN GO TO FINISH;
   PDATA:= PDATA + 4;
   YEAR:= INTEGER(PDATA,4);
   PDATA:= PDATA + 4;
   MONTH:= INTEGER(PDATA,2);
   PDATA:= PDATA + 2;
```

```
MODAY:= INTEGER(PDATA,2);
DAY:= DAYS[MONTH] + MODAY;

FOR HR:=1 STEP 1 UNTIL 24 DO
   BEGIN
   PDATA:= PDATA + 2;                                          3
   DIREC[HR]:= INTEGER(PDATA,2);
   PDATA:= PDATA + 2;
   DATAHR[HR]:= INTEGER(PDATA,2);
   END;
                                                               3
FOR HR:=9 STEP 1 UNTIL 14 DO
   BEGIN
   IF DATAHR[HR] EQL 99 THEN GO TO NODATA;                     3
   DIR:= (DIREC[HR] + 1) DIV 2;
   SPEED[DAY,DIR]:= * + DATAHR[HR];
   NODATA: END;
                                                               3
END;                          %%%%%     END OF DAY LOOP
                                                               2
FINISH:
WRITE(PRINTER, <X50, "9-14 AVERAGES">);
WRITE(PRINTER,/,);
WRITE(PRINTER, <"   DAY      1      2      3      4      5      6      7      8
        DAY      1      2      3      4      5      6      7      8">);

WRITE(PRINTER,/,);

FOR DAY:=1 STEP 1 UNTIL 183 DO WRITE(PRINTER, <9I6,X8,9I6>, DAY, FOR
        D:=1 STEP 1 UNTIL 8 DO SPEED[DAY,D], (DAY+183), FOR D:=1 STEP
        1 UNTIL 8 DO SPEED[DAY+183,D]);

FOR D:=1 STEP 1 UNTIL 8 DO WRITE(AVGWIND, <365(I3)>, FOR DAY:=1 STEP 1
        UNTIL 365 DO SPEED[DAY,D]);

END.
```

PROGRAM TO CALCULATE LINEAR REGRESSION MODELS

To calculate the linear regression models used in Chapter IV we used the Statistical Package for the Social Sciences. Details of the package have been published (1).

[1] Nie, N., Bent, D. H., Hull, C. H., Statistical Package for the Social Sciences, McGraw-Hill, New York, 1970.

PROGRAM TO CALCULATE PREDICTED RESULTS OF A CONTROL STRATEGY

This program uses the parameters calculated by GAUSHAUS to calculate the predicted drop in oxidant when implementing a short term control strategy. (see Chapter III). The program is written in Fortran to run on the UNIX PDP 11 operating system. It also calculates the standard deviations from eight one year surfaces and then creates a file convenient for plotting the data.

PROGRAM TO FIT A SURFACE TO AIR QUALITY DATA

This program uses least squares fitting to data points to optimize the parameters for a non-linear model determined by the user. The program consists mainly of a Fortran subroutine GAUSHAUS developed at the University of Wisconsin Computer Center (Code 00017-00/S0017-00) to run on a CDC 3600. The subroutine is available from the Control Data Corporation.

```
CAT PLOT.F NSTAN.F NSTAN2.F NPER.F RMODEL.F >PLOT.DECK

CAT WTAB.F MMEAN.F NMSTAN.F MODEL.F MPER.F >WTAB.DECK

CAT PLOT.F NSTAN.F NSTAN2.F NPER.F RMODEL.F >PLOT.DECK

CAT WTAB.F MMEAN.F NMSTAN.F MODEL.F MPER.F >WTAB.DECK

      IMPLICIT INTEGER*2 /I-N/
      COMMON /STAN/STAN(50,12)/STAN2/STAN2(50,12)/PER/PER(10,12)
      COMMON /SMEAN/SMEAN(50,12)/SMEAN2/SMEAN2(50,12)/IPLUS/IPLUS
      DIMENSION IOBUF(256)
      NMON=12
      DO 100 IPLUS=1,2
      CALL NSTAN
      CALL NPER
      CALL NSTAN2
      IOBUF(245)=IPLUS
      IOBUF(256)=NMON
      DO 50 IMON=1,NMON
      DO 55 I=1,50
      IOBUF(I)=SMEAN(I,IMON)*100
      IOBUF(I+50)=STAN(I,IMON)*100
      IOBUF(I+100)=SMEAN2(I,IMON)*100
      IOBUF(I+150)=STAN2(I,IMON)*100
55    CONTINUE
      DO 20 I=1,10
20    IOBUF(245+I)=PER(I,IMON)
      WRITE(6)(IOBUF(J),J=1,256)
50    CONTINUE
100   CONTINUE
      END
      SUBROUTINE NSTAN
      IMPLICIT INTEGER*2 /I-N/
      COMMON IDAYOY(750),IOX(750),PREDIC(750)/STAN/STAN(50,12)/NYEARS/NYEARS
      COMMON /TH2/TH2(7,8,2)/SMEAN/SMEAN(50,12)/SMEAN2/SMEAN2(50,12)
      DIMENSION TH(7),SUM(50,12),SOSQRS(50,12)
      DIMENSION PREDIC2(750)
      K=1
      DO 591 II=1,2
      READ(5,505)NYEARS
      DO 591 I=1,NYEARS
591   READ(5,506)(TH2(J,I,II),J=1,7)
505   FORMAT(I1)
      RN =1/SQRT(NYEARS)
      RNN =1/NYEARS
      DO 2 I=1,50
      DO 2 J=1,12
      SOSQRS(I,J)=0
2     SUM(I,J)=0
      DO 100 NY =1,NYEARS
      NACT=0
      DO 50 JO=1,50
      DO 50 JD=15,360,30
      NACT=NACT+1
      IOX(NACT)=JO
50    IDAYOY(NACT)=JD
506   FORMAT(7E11.4)
      DO 503 II=1,7
```

```
503   TH(II)=TH2(II,NY,1)
      CALL MODEL(TH,NACT)
      DO 555 JJ=1,NACT
555   PREDIC2(JJ)=PREDIC(JJ)
      DO 554 II=1,7
554   TH(II)=TH2(II,NY,2)
      CALL MODEL(TH,NACT)
      DO 444 JJ=1,NACT
444   PREDIC(JJ)=PREDIC2(JJ)-PREDIC(JJ)
      NACT=0
      DO 10 I=1,50
      DO 10 J=1,12
      NACT=NACT+1
      SUM(I,J)=PREDIC(NACT)+SUM(I,J)
10    SOSQRS(I,J)=PREDIC(NACT)*PREDIC(NACT)+SOSQRS(I,J)
100   CONTINUE
      DO 20 I=1,50
      DO 20 J=1,12
      SMEAN(I,J)=SUM(I,J)/NYEARS
      STAN(I,J)=(SUM(I,J)*SUM(I,J))/NYEARS
      TEMP=(SOSQRS(I,J)-STAN(I,J))/(NYEARS-1)
678   FORMAT(E10.4)
20    STAN(I,J)=SQRT(TEMP)*RN
583   CONTINUE
99    CONTINUE
      READ(5,506)TH
      CALL MODEL(TH,NACT)
      DO 22 I=1,NACT
22    PREDIC2(I)=PREDIC(I)
      READ(5,506)TH
      CALL MODEL(TH,NACT)
      NACT=0
      DO 25 I=1,50
      DO 25 J=1,12
      NACT=NACT+1
      SMEAN(I,J)=PREDIC2(NACT)-PREDIC(NACT)
25    SMEAN2(I,J)=IOX(NACT)-PREDIC2(NACT)
7     FORMAT(25("_",I3))
      END
      SUBROUTINE NSTAN2
      IMPLICIT INTEGER*2 /I-N/
      COMMON IDAYOY(750),IOX(750),PREDIC(750)/STAN2/STAN(50,12)/NYEARS/NYEARS
      COMMON /TH2/TH2(7,8,2)
      DIMENSION TH(7),SUM(50,12),SMEAN(50,12),SOSQRS(50,12)
      K=1
505   FORMAT(I1)
      RN =1/SQRT(NYEARS)
      RNN =1/NYEARS
      DO 2 I=1,50
      DO 2 J=1,12
      SOSQRS(I,J)=0
2     SUM(I,J)=0
      DO 100 NY =1,NYEARS
      NACT=0
      DO 50 JO=1,50
      DO 50 JD=15,360,30
      NACT=NACT+1
      IOX(NACT)=JO
50    IDAYOY(NACT)=JD
      DO 30 I=1,7
```

```
30      TH(I)=TH2(I,NY,1)
506     FORMAT(7E11.4)
        CALL MODEL(TH,NACT)
        NACT=0
        DO 10 I=1,50
        DO 10 J=1,12
        NACT=NACT+1
        PREDIC(NACT)=IOX(NACT)-PREDIC(NACT)
        SUM(I,J)=PREDIC(NACT)+SUM(I,J)
10      SOSQRS(I,J)=PREDIC(NACT)*PREDIC(NACT)+SOSQRS(I,J)
100     CONTINUE
        DO 20 I=1,50
        DO 20 J=1,12
        SMEAN(I,J)=SUM(I,J)/NYEARS
        STAN(I,J)=(SUM(I,J)*SUM(I,J))/NYEARS
20      STAN(I,J)=SQRT((SOSQRS(I,J)-STAN(I,J))/(NYEARS-1))*RN
200     CONTINUE
        END
        SUBROUTINE NPER
        IMPLICIT INTEGER*2 /I-N/
        COMMON /PER/PER(10,12)/NYEARS/NYEARS
        DIMENSION YEAR(360)
        DO 99 I=1,12
        DO 99 J=1,10
99      PER(J,I)=0
        DO 100 NY=1,NYEARS
        DO 88 I=0,350,18
88      READ(5,50)(YEAR(I+J),J=1,18)
50      FORMAT(20(18F4.1,X8))
        DO 100 IMON=1,12
        DO 100 IDAY=1,30
        DATUM=YEAR(((IMON-1)*30)+IDAY)
        IF (DATUM.GE.50) DATUM=49
        MCAT =INT(DATUM/5.)+1
100     PER(MCAT,IMON)=PER(MCAT,IMON)+1
        PART=100. / (NYEARS*30)
6       FORMAT(E11.4)
        DO 20 I=1,12
        DO 20 J=1,10
20      PER(J,I)=PER(J,I)*PART
        END
        SUBROUTINE MODEL(TH,NACT)
        IMPLICIT INTEGER*2 /I-N/
        COMMON IDAYOY(750),IOX(750),PREDIC(750)
        DIMENSION TH(7)
        DO 10 I=1,NACT
        OX=IOX(I)
        DAY=IDAYOY(I)
10      PREDIC(I)=TH(1)+TH(2)*COS(.01744*DAY)
&       +TH(3)*OX+TH(4)*OX*COS(.01744*DAY)
&       +TH(5)*OX*SIN(.01744*DAY)+TH(6)*SIN(.01744*DAY)
&       +TH(7)*OX*OX
        RETURN
        END
```

CHAPTER VII

CONCLUSION

Some Preliminary Thoughts on the Origin of the Weekday-Weekend Effect

Different oxidant patterns result in the atmosphere under different conditions from the same decrease and redistribution of emissions on weekends; under some conditions oxidant concentrations rise on weekends and under other conditions weekend oxidant concentrations decrease. Possible explanations for this phenomenon involve both chemical and meteorological factors. It is assumed in the following discussion that those meteorological variables which influence the mixing depth and rate of formation of oxidant including temperature, relative humidity, wind speed and inversion height are essentially independent of the day of the week. Therefore, the only difference between weekdays and weekends is the level and distribution of emissions.

One would normally expect that a decrease in atmospheric concentrations of reactants, i.e. the primary pollutants, would result in a reduction in the concentrations of products (ozone and other oxidants). This has been the usual viewpoint used, for example, to explain the observation that there has never been an alert called in Los Angeles on a Sunday -- the lowered emission levels keep oxidant concentration below alert levels. However, as seen above, this will not explain all the observations, and thus other factors must be involved.

Confined to a limited volume by the inversion layer, the reacting pollutants are also moved about the air basin by the winds. Winds in the Los Angeles Air Basin are from the ocean in late morning and afternoon and from the land in the late night and early morning. As the sea breeze picks up in the morning, it carries eastward fresh pollutants emitted during morning, reacting as they move, collecting fresh pollutants into the air parcel as it is blown over additional source areas. This results in the very high oxidant concentrations observed at the eastern edge of the basin. When the sun sets, the polluted air still contains partially reacted hydrocarbons and NO_x and has the potential to continue the photochemical process with no new influx of primary pollutants. Much of this air is cleared from the basin and blown westward over the ocean at night by the land breeze. When the sea breeze begins to pick up in the morning, it is carried back over the land. The air has the potential to produce some oxidant near the coast without any further influx of pollutants, even though it may have been partially diluted by clean sea air. Thus, as the morning traffic peak adds fresh pollutants to the atmosphere, it already has some potential for the formation of oxidant as carryover from yesterday. Let us examine the effect of this oxidant potential on weekday oxidant concentrations.

In the morning the polluted air mass begins to react and form ozone as it moves over the coast. Concurrent with this process, morning traffic in the source areas begins to emit NO_x (as NO) which can immediately react with the ozone that is being produced in the air mass, keeping oxidant concentrations low. The air mass then begins its flow eastward in the sea breeze with a very high oxidant potential, containing both the carryover and freshly emitted pollutants. As it moves, NO is converted to photochemically active NO_2 after which both the freshly emitted pollutants and the carryover react to form oxidant. Contrast this with the situation on a weekend. The air which has been carried over from the previous day will still arrive in the coastal areas in the morning with its potential for ozone formation, yet there is no rush hour traffic peak and no large influx of primary pollutants, especially NO, to scavenge this ozone. Therefore the weekend air mass at source areas may have just as much potential for creation of oxidant in these coastal areas as on weekdays because of the carry-over of yesterday's pollutants, and the lack of NO to scavenge the ozone. This explains the constancy or even increase of oxidant concentrations on weekends compared to weekdays recorded at coastal stations.

The foregoing process does not accurately describe the situation at inland stations, because at these receptor sites the observed oxidant concentrations result from hours of reaction in the polluted mass as it travels eastward in the sea breeze, while at source sites the daily influx of NO directly affects the recorded oxidant concentrations. High concentrations of NO_x lead to lower oxidant concentrations near the coast, since the dominant form is NO which rapidly reacts to scavenge ozone. As the polluted mass moves eastward and the NO reacts to become NO_2, the increased NO_x levels cause a rise in the amount of oxidant produced. Conversely, decreased NO emissions, while perhaps responsible for some small increase in oxidant concentrations measured at coastal stations, will result in lower NO_2 and oxidant concentrations at the eastern stations. Thus, one might expect that coastal stations would not show a decrease in oxidant concentration on weekends -- the atmosphere retains the ability to produce oxidant due to the combination of carryover pollutants and the lack of fresh NO to scavenge the ozone. At eastern stations during the summer, the weekend decrease of NO_x results in a reduction of oxidant produced on weekends because there is a lower concentration of reactants which can form oxidant as they move across the basin. Inland stations behave like coastal stations during winter, perhaps because the lessened sunlight intensity (the driving force of the photochemical reactions) does not allow the polluted air to reach its full potential of oxidant production.

We have suggested some aspects of a possible explanation of those atmospheric processes which result in the observed patterns of weekday and weekend oxidant. Further studies are necessary to discover if such an explanation is at all realistic. For example, one would like to sample the air over the ocean near the coast to elucidate the fate of pollutants over the ocean. A series of flights at various times during the day could sample hydrocarbons and NO_x to determine the composition of partially reacted mixtures, as well as ozone, and meteorological variables such as wind speed, wind direction and temperature. These should be continued into the night to answer the question of whether ozone observed early in the morning is produced by early morning solar action on the partially reacted pollutants or whether it remains from the previous day due to lack of scavenging processes over the ocean. One would like to discover the composition of partially reacted mixtures as they age without sunlight.

In addition, information could perhaps be gained from smog chamber studies, by trying to simulate the conditions experienced by polluted air over the ocean. One such experiment could begin with irradiation of an auto exhaust surrogate mixture including only primary pollutants. The air could then be left in the chamber in the dark overnight and further irradiated the next morning to determine the full potential for oxidant production in such an air mass. Smog chamber experiments have difficulties due to wall reactions which would be magnified in such lengthy experiments, but the results might still be helpful. To help avoid wall effects when the hydrocarbon mix and hydrocarbon-NO_x ratio of the air over the ocean at night is known, a similar mixture could be irradiated in the smog chamber.

The effect of the weekend-weekday variation of industrial pollutants needs further study. Emissions data segregated by day of the week from the large stationary sources in the Los Angeles basin would be useful in order to determine their weekly patterns. In addition, power plants often have seasonally varying loads, and the extent of the seasonal changes in emissions might help to explain the seasonal changes in the weekday-weekend phenomenon.

We have observed seasonal variations in the response of oxidant concentrations to the change of emissions on weekends. The cause of these variations is still a matter of speculation. However, in spite of our lack of complete chemical and meteorological understanding, we can still use the observed variations to evaluate a short term oxidant control strategy and thus define a subset of conditions under which switching to weekend-type emissions would significantly decrease the average oxidant levels both one and two days into the future.