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Air Quality Trends in Illinois: Update to 1994

Technical Report of the Critical Trends Assessment Project

by
Donald F. Gatz
Office of Air Quality

Prepared for the
Illinois Department of Natural Resources

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Illinois State Water Survey
Atmospheric Sciences Division
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Illinois State Water Survey

ABSTRACT

This report updates a previous report of trends in Illinois air quality, using a data set now extended to 1994. Relative trends were computed for 22 pollutant data sets in four geographic regions and at three concentration levels over the period 1978-1994. Statistical significance was tested using the nonparametric Mann-Kendall test for trend. The results confirm the previous conclusions of mostly downward trends in median regional pollutant concentrations, and indeed extend these conclusions to additional pollutants and to 90th percentile and maximum concentrations as well. Trends in regional median concentrations were compared to trends at individual long-duration sampling sites to test for possible bias in the regional results due to preferential closing of low-concentration sites as budgets tightened over the years. Weak evidence of possible bias for a few pollutants was found only in the Metro-East and Remainder regions.

INTRODUCTION

Purpose

Analyses carried out for the first Critical Trends Assessment Program (CTAP-I) in Illinois by the Illinois Department of Energy and Natural Resources (IDENR, 1994) showed that most air pollutant concentrations statewide were either trending downward or remaining constant over the decade of the 1980s. Since those analyses were completed, four additional years of summary data have been published by the Illinois Environmental Protection Agency (IEPA). The main purpose of this work was to update the earlier temporal trend analyses using data for 1978-1994. Two separate tasks were identified.

Task 1 was to update the air quality summary data files available for public use. A related subtask was to create an additional database of long-duration sampling stations for testing of air quality trends at individual locations. (In the earlier work, only median concentrations within specified geographical areas were tested for trends.)

Task 2 was to retest the updated air quality data sets for overall trends over time. This included conducting trend tests on median concentrations of the same criteria and noncriteria pollutants as in CTAP-I, and within specific geographical areas, as before. In addition, it included conducting trend tests on individual sampling stations with the longest data records, as verification of the results from the more generalized tests.

Scope

Although CTAP-I included analyses of both temporal and spatial trends, *this* update is limited to reexamining the extended data sets for *time* trends only. Because of cutbacks in the number of IEPA monitoring stations in recent years, the ability of the current network to define spatial patterns, even in the Chicago area, which has the highest station density, is severely limited. As before, the analyses in this report rely on data generated by routine air quality measurements carried out by the IEPA, the state agency charged with monitoring compliance with state and national air quality standards. It should be noted that IEPA's main purpose in making these measurements is to monitor compliance with standards, *not* to document the state's air quality. This means that monitoring locations, especially in an era of tight budgets, are often limited to locations where compliance is in doubt. Thus, to some extent, this examination of IEPA data for descriptions of past and current air quality goes beyond the purpose for which the data were originally collected. Consequently, the goal of characterizing air quality over the whole state may not be completely attainable.

Pollutants Analyzed

The air pollutants examined for temporal and spatial trends include, first of all, the seven criteria pollutants, i.e., those for which national or state air quality standards have been set. These include four gaseous pollutants: ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO). Standards have also been set for two pollutants that occur as particles: lead (Pb) and particulate matter with aerodynamic diameters of 10 micrometers (am) or less (PM_{10}).

In addition, the project included examining measured concentrations of several additional pollutants for which standards have not been set. This group includes sulfate and nitrate ions and the metals arsenic (As), cadmium (Cd), chromium (Cr), iron (Fe), manganese (Mn), and nickel (Ni). These pollutants all occur as particles in the atmosphere, and they are measured by chemically analyzing samples collected by high-volume filter samplers. Several additional metals, such as beryllium, copper, selenium, and vanadium, are currently being measured or have been measured by IEPA in the past. These additional metals are not included in this assessment because their concentrations were almost always smaller than the detection limit.

Period of Record

The Illinois data analyzed represent, at the most, the years between 1978 and 1994. Lead measurements began in 1979. PM_{10} and some of the metals were measured only during the later years of this time period, and total suspended particulate matter (TSP) was not reported for 1994.

Data Quality

Methods of air pollutant sampling and analysis used by IEPA conform to U.S. EPA standards. However, it should be noted that artifacts can occur on certain types of filters possibly used by IEPA for high-volume sampling during the data period. Positive sulfate artifacts (formation of sulfate on the filter from gaseous precursors) have been reported (Appel et al., 1984). Both positive and negative (evaporative loss) artifacts can occur for nitrate (Appel et al., 1984).

METHODS

Methods related to data acquisition and creation of computer files were described in the CTAP-I report on critical environmental trends in Illinois (IDENR, 1994). The additional summary data used in this report were taken from IEPA annual reports for 1991-1994 (IEPA, 1992, 1993, 1994, 1995). The geographical areas within the state were defined as used previously in the CTAP-I report, with one exception. In the earlier work, if there were not enough sampling sites in the Metro-East area to justify estimating trends, the Metro-East sites were included in the "Remainder of State" group. For this report, sites were fixed in all geographical areas according to U.S. EPA Air Quality Control Region (AQCR). The Chicago area is the Illinois portion of AQCR 67. The Metro-East area is the Illinois portion of AQCR 70. The area designated as "Remainder of the State" included the Illinois portions of AQCR 65, 66, 68, 69, 71, 72, 73, and 74.

Time sequences of pollutant concentrations were tested for statistical significance of time trends using the nonparametric Mann-Kendall test (Gilbert, 1987). Computed Mann-Kendall statistics were tested for significance using probabilities given by Hollander and Wolfe's (1973) table A21. The test was applied to three data series, specifically the medians, the 90th percentile values, and the maximum values, of the distributions made up of annual summary values from each sampling site in each geographic area. It was also applied to various annual summary data at individual sites.

RESULTS

Trend results are presented primarily by geographic region. The regional results are complemented by, and compared to, results for individual long-duration sampling sites within each region. The regional results appear in three tables and a series of figures showing trend plots. The trend results for individual sites, and comparisons to trends in their respective regional median values, are given in 14 tables. After a brief introduction of the tables, regional trends of individual pollutants are discussed in terms of computed trend rates, correlations of pollutant concentrations between geographic areas, comparisons between regional and individual site results, and the trend plots.

Annual Concentration Data by Geographic Region

Table 1 is an updated version of table 1 in the earlier CTAP-I report (IDENR, 1994). The table has also been expanded to show the number of sampling sites with valid data for each year in each region. In addition to the regional *median* values given in the earlier report, the 90th percentile and maximum values are now also included. This is to enable statistical assessments of trends in the upper ends of the various regional pollutant concentration distributions, in addition to trends in the medians. Trends in the upper ends of these distributions are of great interest because they may show current progress toward meeting air quality criteria.

Time Trends in Regional Pollutant Concentrations

Table 2 summarizes trends in regional pollutant concentrations. The trend values are the mean annual percent change, computed from all possible combinations of annual values in table 1, relative to the overall regional mean concentrations during the data period (again from table 1). Trends were computed separately for median, 90th percentile, and maximum values in each geographic region. The resulting values are best considered as *relative* indices of the trend rates. For example, a few large year-to-year changes early in the data period, followed by a longer series of smaller changes, will produce a large mean change relative to the overall long-term mean concentration. Such mean percent changes can range up to 20% per year or more. That amount seems too high if one assumes that the base is the *beginning concentration,* since it would only take 5 years to reduce that concentration to zero, but it is reasonable over a 17-year period relative to the smaller 17-year mean, if concentrations have fallen substantially.

These trends are based on annual data summaries published by the IEPA for 1978-1994. Four additional years of data are included here that were not available for the CTAP-I report (IDENR, 1994). Another difference from the results in the CTAP-I report is the statistical test used to compute probabilities that the trends occurred by chance. The widely used Mann-Kendall test for trend (Gilbert, 1987) was used here; the earlier work used the Spearman Rank Correlation Coefficient. Both tests are nonparametric.

Table 2 gives results for 22 pollutant entities, four geographical areas, and three concentration levels (median, 90th percentile, and maximum values), or 264 separate possible tests for trend. In 35 cases (13%) the available data were inadequate (too few years) for testing. Trends were significant at the 1% level in 117 cases (44%) and at 5% in an additional 39 cases (15%). In the remaining 73 cases (28%), the trends were not significant.

The significant trends are overwhelmingly negative (downward); i.e, toward lower concentrations. Only five (4%) of the 117 trends significant at 1% were positive (upward), and only two (5%) of the additional 39 trends significant at 5% were positive. Thus, about 95% of the trends significant at 5% or better were downward.

Table 1. Summary of Pollutant Concentration Distributions over Sampling Stations In Four Geographic Areas.

	Statewide				Chicago area				Metro-East area				Remainder of state			
Year	(n)*	Median	90th pctile	Maximum	(n)	Median	90th pctile	Maximum	(n)	Median	90th pctile	Maximum	(n)	Median	90th pctile	Maximum
CO: Maximum 1-hr mean, ppm																
1978	(16)	11.1	24.2	26.4	(10)	10.9	25.7	26.4	(3)	10.9	—**	16.0	(3)	13.6	—	14.0
1979	(17)	12.1	19.1	24.3	(11)	12.1	20.2	24.3	(3)	15.0	—	19.1	(3)	17.0	—	19.0
1980	(12)	12.8	18.6	22.9	(6)	13.0	22.3	22.9	(3)	13.2	—	15.6	(3)	12.3	—	15.1
1981	(15)	16.1	22.5	23.1	(8)	12.7	22.0	22.5	(3)	13.1	—	19.9	(4)	19.7	—	23.1
1982	(13)	13.5	18.4	21.4	(6)	10.4	20.6	21.4	(3)	13.2	—	14.5	(4)	15.2	—	17.7
1983	(14)	14.2	21.2	31.0	(7)	14.4	28.5	31.0	(3)	11.6	—	20.1	(4)	13.9	—	17.3
1984	(13)	14.0	18.1	19.7	(7)	13.0	16.9	17.0	(2)	13.0	—	14.0	(4)	16.7	—	19.7
1985	(14)	10.0	15.5	16.8	(8)	9.7	16.3	16.8	(2)	9.9	—	10.1	(4)	11.5	—	15.4
1986	(15)	8.9	14.7	14.8	(8)	8.5	13.9	14.8	(2)	8.9	—	9.3	(5)	11.6	—	14.7
1987	(12)	9.8	16.4	18.6	(6)	8.8	14.1	14.6	(2)	9.0	—	9.1	(4)	13.9	—	18.6
1988	(17)	9.3	14.9	19.6	(11)	9.1	12.0	14.3	(2)	7.7	—	8.3	(4)	13.2	—	19.6
1989	(17)	8.6	13.2	13.9	(11)	7.3	10.1	10.6	(2)	13.6	—	13.9	(4)	10.6	—	13.2
1990	(17)	9.5	15.1	17.5	(11)	8.9	14.4	17.5	(2)	9.5	—	10.0	(4)	10.9	—	15.8
1991	(11)	9.9	11.6	12.3	(7)	9.9	10.5	10.6	(1)	6.1	—	6.1	(3)	11.2	—	12.3
1992	(11)	8.5	13.3	16.4	(7)	8.5	10.8	10.9	(1)	5.4	—	5.4	(3)	11.2	—	16.4
1993	(10)	8.0	10.9	11.5	(7)	7.9	9.8	10.2	(1)	8.0	—	8.0	(2)	8.9	—	11.5
1994	(11)	8.4	11.5	12.3	(7)	10.4	12.0	12.3	(1)	7.4	—	7.4	(3)	8.2	—	8.4
CO: Maximum 8-hr mean, ppm																
1978	(16)	7.7	13.9	16.8	(10)	7.2	15.4	16.8	(3)	8.2	—	10.0	(3)	7.7	—	8.8
1979	(17)	8.7	12.5	16.0	(11)	8.6	13.9	16.0	(3)	8.7	—	12.4	(3)	10.1	—	11.0
1980	(12)	8.0	12.0	14.0	(6)	7.4	13.5	14.0	(3)	8.1	—	8.6	(3)	8.1	—	11.2
1981	(15)	9.0	10.6	11.1	(8)	8.8	10.5	10.6	(3)	8.1	—	10.6	(4)	9.6	—	11.1
1982	(13)	6.9	10.9	15.5	(6)	6.1	14.7	15.5	(3)	5.9	—	6.4	(4)	8.8	—	9.7
1983	(14)	9.3	13.1	13.8	(7)	10.9	13.6	13.8	(3)	6.1	—	6.3	(4)	8.6	—	9.7
1984	(13)	8.9	12.0	12.0	(7)	8.9	11.9	12.0	(2)	7.0	—	7.0	(4)	11.0	—	12.0
1985	(14)	6.2	8.2	8.3	(8)	5.6	8.1	8.3	(2)	6.2	—	6.2	(4)	6.8	—	8.2
1986	(15)	5.8	9.1	9.4	(8)	5.5	8.5	9.1	(2)	4.8	—	5.9	(5)	7.5	—	9.4
1987	(12)	5.3	11.0	13.2	(6)	5.3	9.6	10.0	(2)	5.1	—	5.2	(4)	7.3	—	13.2
1988	(17)	5.3	8.4	8.8	(11)	5.3	7.6	8.4	(2)	5.1	—	5.2	(4)	7.3	—	8.8
1989	(17)	5.1	8.1	9.4	(11)	4.8	6.0	7.0	(2)	8.1	—	8.1	(4)	5.6	—	9.4
1990	(17)	5.3	8.4	8.5	(11)	3.7	8.5	8.5	(2)	5.5	—	5.9	(4)	6.0	—	7.9
1991	(11)	5.6	7.3	7.7	(7)	5.6	7.3	7.7	(1)	4.4	—	4.4	(3)	6.3	—	7.1
1992	(11)	5.1	7.5	9.2	(7)	5.3	6.2	6.3	(1)	3.8	—	3.8	(3)	5.0	—	9.2
1993	(10)	5.0	7.7	8.8	(7)	5.2	6.4	6.6	(1)	3.7	—	3.7	(2)	6.8	—	8.8
1994	(11)	6.6	9.4	9.7	(7)	8.2	9.6	9.7	(1)	4.3	—	4.3	(3)	4.1	—	6.6

Table 1. Summary of Pollutant Concentration Distributions over Sampling Stations In Four Geographic Areas (continued).

	Statewide				Chicago area				Metro-East area				Remainder of state			
Year	(n)*	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum
Pb: Annual mean, micrograms/cubic meter																
1979	(93)	0.43	0.70	2.71	(52)	0.43	0.66	0.81	(16)	0.65	1.23	2.71	(25)	0.34	0.49	0.54
1980	(101)	0.32	0.53	1.75	(60)	0.37	0.58	0.92	(15)	0.39	0.82	1.75	(26)	0.23	0.33	0.37
1981	(97)	0.26	0.43	3.03	(60)	0.29	0.40	0.58	(16)	0.35	0.82	3.03	(21)	0.16	0.27	0.28
1982	(46)	0.29	0.44	1.36	(35)	0.29	0.38	0.51	(5)	0.71	----	1.36	(6)	0.16	0.23	0.23
1983	(46)	0.29	0.51	0.78	(34)	0.28	0.49	0.53	(7)	0.40	0.75	0.78	(5)	0.15	----	0.19
1984	(45)	0.25	0.44	0.75	(33)	0.24	0.39	0.53	(7)	0.32	0.72	0.75	(5)	0.13	----	0.20
1985	(51)	0.15	0.26	0.50	(37)	0.13	0.22	0.50	(8)	0.27	0.37	0.38	(6)	0.07	0.10	0.10
1986	(39)	0.08	0.24	0.33	(27)	0.08	0.17	0.29	(7)	0.22	0.33	0.33	(5)	0.05	----	0.07
1987	(31)	0.06	0.25	0.32	(21)	0.06	0.11	0.14	(6)	0.26	0.32	0.32	(4)	0.04	----	0.06
1988	(19)	0.05	0.22	0.28	(11)	0.05	0.09	0.10	(5)	0.17	----	0.28	(3)	0.02	----	0.05
1989	(15)	0.04	0.17	0.24	(7)	0.04	0.12	0.13	(4)	0.17	----	0.24	(4)	0.03	----	0.04
1990	(17)	0.05	0.16	0.21	(8)	0.06	0.11	0.11	(4)	0.16	----	0.21	(5)	0.02	----	0.05
1991	(18)	0.04	0.14	0.23	(9)	0.03	0.07	0.07	(5)	0.13	----	0.23	(4)	0.03	----	0.03
1992	(23)	0.07	0.79	2.33	(12)	0.07	0.69	0.70	(6)	0.16	2.21	2.33	(5)	0.02	----	0.04
1993	(25)	0.05	0.60	2.28	(13)	0.05	0.44	0.48	(7)	0.12	1.98	2.28	(5)	0.02	----	0.02
1994	(26)	0.06	0.67	3.47	(13)	0.05	0.41	0.47	(8)	0.13	2.68	3.47	(5)	0.02	----	0.03
NO2: Maximum 1-hr mean, ppm																
1978	(7)	0.176	0.309	0.323	(5)	0.225	----	0.323	(0)	----	----	----	(2)	0.138	----	0.148
1979	(13)	0.138	0.264	0.340	(8)	0.146	0.302	0.340	(3)	0.119	----	0.122	(2)	0.164	----	0.245
1980	(4)	0.148	----	0.164	(4)	0.148	----	0.164	(0)	----	----	----	(0)	----	----	----
1981	(4)	0.202	----	0.274	(4)	0.202	----	0.274	(0)	----	----	----	(0)	----	----	----
1982	(5)	0.132	----	0.138	(5)	0.132	----	0.138	(0)	----	----	----	(0)	----	----	----
1983	(11)	0.132	0.187	0.195	(9)	0.147	0.189	0.195	(2)	0.120	----	0.131	(0)	----	----	----
1984	(11)	0.116	0.151	0.170	(9)	0.129	0.157	0.170	(2)	0.110	----	0.112	(0)	----	----	----
1985	(11)	0.133	0.166	0.167	(10)	0.134	0.167	0.167	(1)	0.084	----	0.084	(0)	----	----	----
1986	(10)	0.106	0.151	0.164	(9)	0.099	0.153	0.164	(1)	0.123	----	0.123	(0)	----	----	----
1987	(9)	0.115	0.170	0.176	(8)	0.115	0.159	0.176	(1)	0.160	----	0.160	(0)	----	----	----
1988	(14)	0.126	0.186	0.200	(13)	0.129	0.187	0.200	(1)	0.108	----	0.108	(0)	----	----	----
1989	(14)	0.113	0.134	0.150	(13)	0.113	0.136	0.150	(1)	0.093	----	0.093	(0)	----	----	----
1990	(16)	0.089	0.111	0.150	(14)	0.089	0.115	0.150	(1)	0.068	----	0.068	(1)	0.043	----	0.043
1991	(11)	0.095	0.121	0.125	(9)	0.099	0.123	0.125	(1)	0.070	----	0.070	(1)	0.053	----	0.053
1992	(8)	0.096	0.105	0.105	(7)	0.096	0.105	0.105	(1)	0.084	----	0.084	(0)	----	----	----
1993	(9)	0.088	0.102	0.105	(8)	0.089	0.103	0.105	(1)	0.086	----	0.086	(0)	----	----	----
1994	(10)	0.112	0.137	0.153	(9)	0.112	0.140	0.153	(1)	0.068	----	0.068	(0)	----	----	----

Table 1. Summary of Pollutant Concentration Distributions over Sampling Stations In Four Geographic Areas (continued).

	Statewide				Chicago area				Metro-East area				Remainder of state			
Year	(n)*	Median	90th pctile	Maximum	(n)	Median	90th pctile	Maximum	(n)	Median	90th pctile	Maximum	(n)	Median	90th pctile	Maximum
NO2: Maximum 24-hr mean, ppm																
1978	(43)	0.097	0.172	0.218	(41)	0.097	0.172	0.218	(0)	----	----	----	(2)	0.078	----	0.107
1979	(47)	0.094	0.136	0.173	(42)	0.095	0.145	0.173	(3)	0.053	----	0.070	(2)	0.070	----	0.098
1980	(24)	0.097	0.130	0.142	(24)	0.097	0.130	0.142	(0)	----	----	----	(0)	----	----	----
1981	(23)	0.074	0.102	0.109	(23)	0.074	0.102	0.109	(0)	----	----	----	(0)	----	----	----
1982	(23)	0.085	0.099	0.123	(23)	0.085	0.099	0.123	(0)	----	----	----	(0)	----	----	----
1983	(23)	0.080	0.114	0.133	(21)	0.090	0.115	0.133	(2)	0.060	----	0.067	(0)	----	----	----
1984	(23)	0.057	0.077	0.096	(21)	0.057	0.078	0.096	(2)	0.055	----	0.063	(0)	----	----	----
1985	(18)	0.064	0.078	0.094	(17)	0.065	0.078	0.094	(1)	0.054	----	0.054	(0)	----	----	----
1986	(10)	0.055	0.074	0.081	(9)	0.056	0.075	0.081	(1)	0.046	----	0.046	(0)	----	----	----
1987	(9)	0.059	0.085	0.095	(8)	0.060	0.087	0.095	(1)	0.055	----	0.055	(0)	----	----	----
1988	(14)	0.063	0.079	0.081	(13)	0.065	0.079	0.081	(1)	0.045	----	0.045	(0)	----	----	----
1989	(14)	0.062	0.070	0.076	(13)	0.063	0.070	0.076	(1)	0.049	----	0.049	(0)	----	----	----
1990	(16)	0.048	0.059	0.062	(14)	0.050	0.059	0.062	(1)	0.035	----	0.035	(1)	0.020	----	0.020
1991	(11)	0.052	0.072	0.082	(9)	0.053	0.075	0.082	(1)	0.039	----	0.039	(1)	0.027	----	0.027
1992	(8)	0.057	0.069	0.069	(7)	0.063	0.069	0.069	(1)	0.043	----	0.043	(0)	----	----	----
1993	(9)	0.056	0.060	0.060	(8)	0.053	0.060	0.060	(1)	0.058	----	0.058	(0)	----	----	----
1994	(10)	0.058	0.063	0.063	(9)	0.059	0.063	0.063	(1)	0.039	----	0.039	(0)	----	----	----
NO2: Annual mean, ppm																
1978	(36)	0.045	0.055	0.060	(36)	0.045	0.055	0.060	(0)	----	----	----	(0)	----	----	----
1979	(33)	0.051	0.067	0.078	(32)	0.051	0.067	0.078	(1)	0.014	----	0.014	(0)	----	----	----
1980	(21)	0.047	0.053	0.060	(21)	0.047	0.053	0.060	(0)	----	----	----	(0)	----	----	----
1981	(21)	0.042	0.048	0.050	(21)	0.042	0.048	0.050	(0)	----	----	----	(0)	----	----	----
1982	(18)	0.039	0.046	0.052	(18)	0.039	0.046	0.052	(0)	----	----	----	(0)	----	----	----
1983	(21)	0.029	0.038	0.044	(19)	0.030	0.038	0.044	(2)	0.025	----	0.025	(0)	----	----	----
1984	(21)	0.028	0.036	0.044	(19)	0.029	0.037	0.044	(2)	0.024	----	0.025	(0)	----	----	----
1985	(13)	0.027	0.042	0.042	(12)	0.028	0.042	0.042	(1)	0.022	----	0.022	(0)	----	----	----
1986	(10)	0.024	0.176	0.310	(9)	0.025	0.202	0.310	(1)	0.023	----	0.023	(0)	----	----	----
1987	(9)	0.024	0.038	0.043	(8)	0.026	0.039	0.043	(1)	0.023	----	0.023	(0)	----	----	----
1988	(8)	0.023	0.031	0.031	(7)	0.022	0.031	0.031	(1)	0.024	----	0.024	(0)	----	----	----
1989	(14)	0.027	0.032	0.034	(13)	0.027	0.032	0.034	(1)	0.023	----	0.023	(0)	----	----	----
1990	(9)	0.024	0.030	0.031	(8)	0.025	0.030	0.031	(1)	0.021	----	0.021	(0)	----	----	----
1991	(10)	0.020	0.031	0.032	(8)	0.022	0.031	0.032	(1)	0.021	----	0.021	(1)	0.008	----	0.008
1992	(7)	0.025	0.030	0.030	(6)	0.027	0.030	0.030	(1)	0.019	----	0.019	(0)	----	----	----
1993	(9)	0.025	0.030	0.030	(8)	0.026	0.030	0.030	(1)	0.019	----	0.019	(0)	----	----	----
1994	(8)	0.028	0.032	0.032	(7)	0.029	0.032	0.032	(1)	0.020	----	0.020	(0)	----	----	----

Table 1. Summary of Pollutant Concentration Distributions over Sampling Stations in Four Geographic Areas (continued).

	Statewide				Chicago area				Metro-East area				Remainder of state			
Year	(n)*	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum
O3: Maximum 1-hr mean, ppm																
1978	(39)	0.137	0.214	0.263	(21)	0.151	0.244	0.263	(6)	0.171	0.196	0.197	(12)	0.118	0.140	0.160
1979	(43)	0.118	0.152	0.186	(24)	0.122	0.163	0.186	(6)	0.127	0.141	0.141	(13)	0.103	0.136	0.152
1980	(39)	0.121	0.161	0.170	(20)	0.126	0.157	0.163	(7)	0.142	0.168	0.170	(12)	0.105	0.149	0.170
1981	(44)	0.115	0.164	0.176	(20)	0.142	0.173	0.176	(7)	0.123	0.128	0.128	(17)	0.098	0.124	0.128
1982	(38)	0.110	0.137	0.148	(18)	0.117	0.141	0.147	(7)	0.118	0.146	0.148	(13)	0.094	0.109	0.113
1983	(39)	0.137	0.178	0.214	(18)	0.158	0.179	0.188	(7)	0.154	0.208	0.214	(14)	0.107	0.128	0.151
1984	(36)	0.126	0.152	0.172	(17)	0.127	0.166	0.172	(7)	0.138	0.145	0.146	(12)	0.104	0.134	0.134
1985	(39)	0.111	0.146	0.152	(20)	0.115	0.147	0.148	(7)	0.127	0.151	0.152	(12)	0.101	0.129	0.135
1986	(35)	0.111	0.128	0.145	(17)	0.111	0.126	0.128	(6)	0.131	0.145	0.145	(12)	0.099	0.121	0.121
1987	(34)	0.122	0.154	0.164	(17)	0.139	0.161	0.164	(6)	0.126	0.153	0.154	(11)	0.106	0.120	0.122
1988	(37)	0.127	0.170	0.223	(18)	0.128	0.214	0.223	(6)	0.147	0.152	0.152	(13)	0.113	0.147	0.150
1989	(39)	0.110	0.124	0.138	(19)	0.113	0.126	0.130	(6)	0.117	0.136	0.138	(14)	0.103	0.113	0.116
1990	(40)	0.093	0.121	0.128	(19)	0.093	0.106	0.115	(6)	0.118	0.124	0.124	(15)	0.090	0.127	0.128
1991	(41)	0.121	0.137	0.152	(20)	0.124	0.145	0.152	(6)	0.118	0.138	0.140	(15)	0.109	0.133	0.138
1992	(40)	0.103	0.132	0.149	(20)	0.121	0.135	0.149	(6)	0.102	0.111	0.112	(14)	0.094	0.104	0.112
1993	(39)	0.092	0.124	0.136	(21)	0.092	0.108	0.118	(6)	0.124	0.136	0.136	(12)	0.083	0.115	0.135
1994	(40)	0.107	0.129	0.169	(22)	0.110	0.131	0.169	(6)	0.121	0.136	0.137	(12)	0.101	0.121	0.122
SO2: Maximum 3-hr mean, ppm																
1978	(30)	0.146	0.324	0.448	(12)	0.113	0.202	0.250	(5)	0.176	—	0.448	(13)	0.225	0.364	0.364
1979	(35)	0.132	0.327	0.428	(18)	0.131	0.250	0.398	(6)	0.161	0.418	0.428	(11)	0.120	0.331	0.411
1980	(26)	0.136	0.279	0.597	(9)	0.145	0.204	0.212	(6)	0.171	0.560	0.597	(11)	0.102	0.302	0.336
1981	(29)	0.135	0.299	0.425	(13)	0.115	0.150	0.153	(6)	0.167	0.404	0.425	(10)	0.094	0.322	0.326
1982	(31)	0.124	0.236	0.313	(14)	0.116	0.200	0.251	(6)	0.198	0.311	0.313	(11)	0.093	0.210	0.226
1983	(31)	0.098	0.269	0.492	(15)	0.090	0.140	0.152	(5)	0.200	—	0.492	(11)	0.112	0.269	0.276
1984	(30)	0.120	0.314	0.354	(14)	0.096	0.209	0.309	(5)	0.319	—	0.354	(11)	0.145	0.274	0.290
1985	(30)	0.120	0.261	0.446	(14)	0.109	0.198	0.446	(6)	0.174	0.271	0.273	(10)	0.113	0.256	0.282
1986	(30)	0.121	0.378	0.596	(14)	0.102	0.211	0.596	(6)	0.243	0.447	0.448	(10)	0.131	0.302	0.313
1987	(27)	0.153	0.313	0.477	(11)	0.131	0.202	0.246	(6)	0.311	0.461	0.477	(10)	0.133	0.248	0.258
1988	(28)	0.136	0.308	0.508	(11)	0.088	0.122	0.153	(8)	0.190	0.450	0.508	(9)	0.177	0.325	0.350
1989	(28)	0.125	0.331	0.358	(11)	0.087	0.122	0.129	(8)	0.290	0.351	0.358	(9)	0.127	0.308	0.338
1990	(28)	0.112	0.239	0.306	(11)	0.066	0.103	0.132	(8)	0.167	0.239	0.246	(9)	0.128	0.290	0.306
1991	(30)	0.121	0.250	0.459	(11)	0.088	0.254	0.459	(8)	0.191	0.253	0.262	(11)	0.140	0.249	0.252
1992	(31)	0.145	0.324	0.498	(12)	0.079	0.173	0.210	(8)	0.206	0.454	0.498	(11)	0.145	0.324	0.347
1993	(30)	0.102	0.224	0.534	(12)	0.074	0.141	0.158	(8)	0.156	0.441	0.534	(10)	0.108	0.225	0.226
1994	(30)	0.117	0.286	0.440	(12)	0.082	0.119	0.125	(8)	0.228	0.401	0.440	(10)	0.124	0.266	0.284

Table 1. Summary of Pollutant Concentration Distributions over Sampling Stations In Four Geographic Areas (continued).

	Statewide				Chicago area				Metro-East area				Remainder of state			
Year	(n)*	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum
SO2: Maximum 24-hr mean, ppm																
1978	(62)	0.050	0.116	0.177	(44)	0.044	0.073	0.164	(5)	0.094	—	0.177	(13)	0.071	0.129	0.139
1979	(64)	0.080	0.113	0.248	(47)	0.082	0.112	0.129	(6)	0.074	0.239	0.248	(11)	0.056	0.140	0.216
1980	(42)	0.047	0.104	0.253	(25)	0.040	0.063	0.253	(6)	0.077	0.142	0.147	(11)	0.045	0.136	0.153
1981	(29)	0.064	0.105	0.146	(13)	0.065	0.091	0.101	(6)	0.062	0.144	0.146	(10)	0.048	0.104	0.107
1982	(31)	0.056	0.088	0.110	(14)	0.062	0.084	0.088	(6)	0.070	0.108	0.110	(11)	0.040	0.076	0.089
1983	(31)	0.042	0.094	0.195	(15)	0.041	0.057	0.058	(5)	0.072	—	0.195	(11)	0.042	0.094	0.121
1984	(30)	0.053	0.133	0.159	(14)	0.046	0.091	0.156	(5)	0.127	—	0.159	(11)	0.064	0.107	0.137
1985	(30)	0.051	0.114	0.130	(14)	0.045	0.090	0.130	(6)	0.091	0.107	0.107	(10)	0.045	0.123	0.124
1986	(30)	0.051	0.117	0.169	(14)	0.044	0.078	0.169	(6)	0.098	0.117	0.117	(10)	0.040	0.118	0.139
1987	(27)	0.051	0.119	0.140	(11)	0.044	0.063	0.072	(6)	0.119	0.139	0.140	(10)	0.053	0.092	0.110
1988	(28)	0.052	0.140	0.186	(11)	0.042	0.054	0.058	(8)	0.093	0.140	0.148	(9)	0.074	0.175	0.186
1989	(28)	0.046	0.119	0.132	(11)	0.031	0.049	0.050	(8)	0.096	0.130	0.132	(9)	0.058	0.111	0.118
1990	(28)	0.040	0.082	0.099	(11)	0.026	0.054	0.083	(8)	0.052	0.083	0.085	(9)	0.048	0.091	0.099
1991	(30)	0.048	0.077	0.329	(11)	0.032	0.165	0.329	(8)	0.056	0.069	0.069	(11)	0.050	0.097	0.119
1992	(31)	0.039	0.099	0.200	(12)	0.029	0.072	0.115	(8)	0.078	0.178	0.200	(11)	0.039	0.079	0.089
1993	(30)	0.043	0.095	0.135	(12)	0.036	0.066	0.083	(8)	0.050	0.126	0.135	(10)	0.046	0.099	0.118
1994	(30)	0.048	0.116	0.186	(12)	0.041	0.058	0.070	(8)	0.076	0.148	0.157	(10)	0.045	0.131	0.186
SO2: Annual mean, ppm																
1978	(52)	0.009	0.016	0.023	(38)	0.008	0.014	0.018	(4)	0.018	—	0.023	(10)	0.013	0.016	0.016
1979	(52)	0.012	0.019	0.022	(36)	0.012	0.019	0.022	(6)	0.015	0.022	0.022	(10)	0.010	0.014	0.016
1980	(39)	0.008	0.015	0.024	(25)	0.008	0.015	0.016	(5)	0.014	—	0.024	(9)	0.007	0.012	0.013
1981	(25)	0.009	0.012	0.021	(11)	0.009	0.011	0.011	(6)	0.012	0.020	0.021	(8)	0.006	0.008	0.009
1982	(27)	0.007	0.013	0.015	(11)	0.008	0.010	0.011	(6)	0.012	0.015	0.015	(10)	0.006	0.009	0.010
1983	(29)	0.008	0.015	0.020	(13)	0.009	0.012	0.014	(5)	0.015	—	0.020	(11)	0.007	0.009	0.011
1984	(27)	0.008	0.016	0.020	(11)	0.008	0.013	0.013	(5)	0.016	—	0.020	(11)	0.006	0.010	0.013
1985	(29)	0.008	0.016	0.018	(13)	0.008	0.016	0.018	(6)	0.014	0.018	0.018	(10)	0.006	0.011	0.013
1986	(27)	0.008	0.015	0.017	(11)	0.006	0.013	0.014	(6)	0.014	0.017	0.017	(10)	0.006	0.011	0.012
1987	(26)	0.008	0.013	0.017	(11)	0.008	0.009	0.011	(6)	0.012	0.017	0.017	(9)	0.007	0.011	0.012
1988	(26)	0.008	0.014	0.017	(11)	0.007	0.010	0.011	(6)	0.012	0.017	0.017	(9)	0.007	0.012	0.014
1989	(27)	0.007	0.013	0.013	(11)	0.007	0.009	0.011	(8)	0.013	0.013	0.013	(8)	0.006	0.011	0.012
1990	(26)	0.007	0.011	0.015	(11)	0.007	0.009	0.010	(8)	0.010	0.014	0.015	(7)	0.004	0.008	0.008
1991	(29)	0.007	0.011	0.019	(10)	0.008	0.015	0.019	(8)	0.008	0.013	0.014	(11)	0.007	0.009	0.010
1992	(29)	0.006	0.010	0.012	(11)	0.005	0.008	0.009	(8)	0.008	0.011	0.012	(10)	0.006	0.008	0.009
1993	(29)	0.006	0.011	0.013	(12)	0.005	0.008	0.008	(8)	0.008	0.011	0.011	(9)	0.006	0.012	0.013
1994	(29)	0.006	0.012	0.012	(11)	0.005	0.008	0.009	(8)	0.008	0.012	0.012	(10)	0.006	0.012	0.012

Table 1. Summary of Pollutant Concentration Distributions over Sampling Stations In Four Geographic Areas (continued).

	Statewide				Chicago area				Metro-East area				Remainder of state			
Year	(n)*	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum
TSP: Maximum 24-hr mean, micrograms/cubic meter																
1978	(151)	189	384	837	(89)	189	352	630	(18)	209	426	837	(44)	184	382	460
1979	(152)	168	284	936	(89)	170	238	535	(20)	217	675	936	(43)	145	309	504
1980	(119)	155	295	614	(63)	156	287	614	(17)	202	366	464	(39)	137	242	507
1981	(116)	162	265	889	(64)	144	210	350	(18)	234	381	889	(34)	163	223	372
1982	(114)	144	229	462	(66)	147	228	460	(16)	167	408	462	(32)	135	203	284
1983	(107)	438	689	937	(58)	496	724	909	(15)	218	395	474	(34)	319	750	937
1984	(109)	139	236	502	(61)	137	225	398	(15)	167	241	362	(33)	139	251	502
1985	(110)	253	437	545	(62)	297	459	545	(15)	179	315	357	(33)	208	327	534
1986	(97)	119	219	423	(52)	123	173	301	(13)	218	376	423	(32)	107	160	284
1987	(90)	141	299	446	(48)	146	280	333	(12)	184	332	354	(30)	132	256	446
1988	(63)	169	282	457	(33)	174	258	413	(8)	188	455	457	(22)	138	236	436
1989	(23)	188	394	777	(11)	188	362	442	(5)	231	—	382	(7)	137	667	777
1990	(24)	220	493	541	(10)	220	316	382	(7)	158	305	313	(7)	237	532	541
1991	(22)	135	224	469	(9)	177	210	212	(6)	135	242	253	(7)	92	411	469
1992	(20)	154	304	354	(9)	189	303	354	(5)	166	—	284	(6)	129	310	324
1993	(19)	149	333	392	(9)	153	384	392	(4)	154	—	275	(6)	115	223	225
TSP: Annual mean, micrograms/cubic meter																
1978	(119)	64	99	176	(72)	63	86	121	(14)	86	154	176	(33)	63	99	109
1979	(127)	68	97	215	(77)	68	92	126	(18)	90	163	215	(32)	62	90	103
1980	(106)	68	101	170	(60)	66	87	119	(17)	84	141	170	(29)	65	99	112
1981	(99)	63	90	190	(58)	60	76	111	(16)	84	139	190	(25)	61	77	97
1982	(95)	51	77	134	(50)	53	68	86	(15)	60	124	134	(30)	47	60	77
1983	(97)	53	77	134	(53)	55	73	93	(15)	63	89	134	(29)	50	62	75
1984	(96)	49	75	119	(51)	51	73	85	(15)	63	92	119	(30)	43	57	66
1985	(104)	48	66	120	(59)	50	66	85	(14)	59	89	120	(31)	43	53	64
1986	(91)	48	79	137	(49)	50	80	97	(13)	68	107	137	(29)	44	58	70
1987	(84)	52	82	147	(47)	53	71	96	(12)	76	125	147	(25)	48	60	82
1988	(57)	56	87	144	(32)	60	81	108	(8)	84	137	144	(17)	51	71	91
1989	(18)	71	113	124	(9)	67	103	117	(4)	90	—	124	(5)	50	—	79
1990	(19)	63	90	124	(7)	65	83	87	(5)	78	—	124	(7)	52	77	81
1991	(19)	57	68	87	(8)	61	67	67	(5)	67	—	87	(6)	44	61	61
1992	(19)	49	81	84	(9)	52	81	84	(4)	64	—	83	(6)	43	58	59
1993	(18)	52	91	95	(8)	60	95	95	(4)	60	—	81	(6)	43	50	50

Table 1. Summary of Pollutant Concentration Distributions over Sampling Stations In Four Geographic Areas (continued).

	Statewide				Chicago area				Metro-East area				Remainder of state			
Year	(n)*	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum
NO3: Annual mean, micrograms/cubic meter																
1978	(110)	5.5	6.4	7.0	(72)	5.5	6.5	7.0	(13)	5.6	6.0	6.2	(25)	5.5	6.2	6.4
1979	(127)	5.4	6.6	7.7	(80)	5.8	6.7	7.7	(17)	5.2	5.9	6.0	(30)	5.2	5.9	6.9
1980	(93)	5.4	6.2	6.9	(48)	4.8	6.0	6.9	(17)	5.5	6.0	6.5	(28)	5.6	6.5	6.7
1981	(86)	5.5	7.3	8.4	(45)	5.8	7.8	8.4	(15)	5.3	5.8	5.9	(26)	5.1	5.9	6.3
1982	(30)	5.2	6.2	6.5	(20)	5.4	6.2	6.5	(4)	4.5	—	5.0	(6)	4.3	4.5	4.5
1983	(46)	6.0	6.8	7.2	(35)	6.3	6.9	7.2	(5)	4.9	—	5.7	(6)	5.2	6.0	6.0
1984	(47)	5.8	6.7	7.2	(36)	6.0	6.9	7.2	(5)	4.2	—	4.6	(6)	4.2	4.7	4.7
1985	(49)	5.0	5.9	6.3	(37)	5.3	6.0	6.3	(6)	3.9	4.4	4.4	(6)	3.4	3.9	3.9
1986	(36)	5.3	6.2	6.6	(26)	5.5	6.3	6.6	(5)	4.1	—	4.4	(5)	3.6	---	3.9
1987	(39)	5.5	6.1	6.5	(29)	5.5	6.1	6.5	(5)	5.7	—	6.1	(5)	4.6	—	4.8
1988	(27)	5.3	5.8	6.2	(18)	5.5	5.9	6.2	(5)	4.8	—	5.0	(4)	4.7	—	5.0
1989	(15)	5.4	6.0	6.4	(7)	5.8	6.3	6.4	(4)	5.1	—	5.3	(4)	4.8	—	5.4
1990	(17)	4.6	5.3	5.5	(8)	4.8	5.4	5.5	(4)	4.6	—	4.7	(5)	4.3	—	4.7
1991	(20)	4.2	4.9	5.0	(10)	4.6	5.0	5.0	(5)	3.9	—	4.1	(5)	4.0	—	4.3
1992	(19)	4.6	5.0	5.2	(10)	4.8	5.1	5.2	(4)	4.3	—	4.6	(5)	4.5	—	4.7
1993	(18)	4.8	5.3	5.5	(9)	5.0	5.4	5.5	(4)	4.2	—	4.8	(5)	4.5	—	4.9
1994	(20)	5.5	6.3	6.4	(10)	5.8	6.4	6.4	(5)	5.2	—	5.5	(5)	5.3	—	5.7
SO4: Annual mean, micrograms/cubic meter																
1978	(124)	11.9	14.6	16.8	(80)	12.1	14.7	16.8	(15)	13.4	15.4	16.3	(29)	10.5	13.8	14.7
1979	(127)	11.9	14.4	18.2	(80)	11.9	14.0	18.2	(17)	13.5	17.0	17.4	(30)	10.8	12.5	16.1
1980	(93)	12.3	15.5	19.6	(48)	12.6	16.3	19.6	(17)	12.9	15.4	16.5	(28)	11.1	13.3	14.6
1981	(86)	12.0	13.8	17.0	(45)	12.0	13.7	15.7	(15)	12.9	16.8	17.0	(26)	11.6	12.8	15.2
1982	(30)	10.5	11.9	14.1	(20)	10.1	11.5	14.1	(4)	11.6	—	13.6	(6)	10.3	12.1	12.2
1983	(46)	12.3	14.1	17.1	(35)	12.2	14.1	17.1	(5)	13.8	—	15.5	(6)	11.0	12.5	12.6
1984	(47)	10.8	12.5	13.2	(36)	10.9	12.8	13.2	(5)	11.2	—	12.0	(6)	9.1	10.9	11.0
1985	(49)	10.2	12.0	16.6	(37)	10.2	11.4	16.6	(6)	11.7	12.8	12.8	(6)	9.0	11.6	11.9
1986	(36)	10.1	12.0	17.7	(26)	10.1	11.6	17.7	(5)	10.8	—	13.3	(5)	8.8	—	12.0
1987	(39)	10.2	13.7	15.9	(29)	10.0	12.1	12.4	(5)	14.2	—	15.9	(5)	10.0	—	13.8
1988	(27)	11.0	12.6	13.6	(18)	10.8	12.1	12.7	(5)	12.1	—	13.6	(4)	9.6	—	13.2
1989	(15)	10.8	12.8	13.6	(7)	10.5	12.0	12.0	(4)	12.6	—	13.6	(4)	10.0	—	12.2
1990	(17)	10.7	13.0	14.1	(8)	10.3	11.5	11.6	(4)	12.5	—	14.1	(5)	9.5	—	11.4
1991	(20)	9.5	11.2	11.7	(10)	9.4	11.6	11.7	(5)	10.8	—	11.0	(5)	8.1	—	9.5
1992	(19)	9.3	11.0	12.1	(10)	9.4	11.5	12.1	(4)	10.3	—	11.2	(5)	8.1	—	9.3
1993	(18)	10.1	11.3	12.6	(9)	10.3	12.0	12.6	(4)	10.5	—	11.4	(5)	8.4	—	9.4
1994	(20)	11.9	13.7	15.3	(10)	11.7	14.3	15.3	(5)	13.1	—	14.0	(5)	11.0	—	12.0

Table 1. Summary of Pollutant Concentration Distributions over Sampling Stations In Four Geographic Areas (continued).

	Statewide				Chicago area				Metro-East area				Remainder of state			
Year	(n)*	Median	90th pctile	Maximum	(n)	Median	90th pctile	Maximum	(n)	Median	90th pctile	Maximum	(n)	Median	90th pctile	Maximum
As: Annual mean, micrograms/cubic meter																
1978	(104)	0.003	0.008	0.039	(60)	0.003	0.007	0.033	(15)	0.008	0.015	0.039	(29)	0.002	0.004	0.004
1979	(86)	0.002	0.005	0.027	(39)	0.002	0.005	0.005	(17)	0.004	0.009	0.027	(30)	0.002	0.003	0.004
1980	(73)	0.002	0.005	0.022	(28)	0.002	0.002	0.003	(17)	0.005	0.010	0.022	(28)	0.002	0.003	0.005
1981	(66)	0.002	0.006	0.035	(25)	0.002	0.002	0.003	(15)	0.004	0.010	0.035	(26)	0.002	0.002	0.006
1982	(12)	0.002	0.018	0.021	(2)	0.002	----	0.002	(4)	0.012	----	0.021	(6)	0.002	0.003	0.003
1983	(15)	0.002	0.010	0.014	(4)	0.002	----	0.002	(5)	0.006	----	0.014	(6)	0.002	0.003	0.003
1984	(15)	0.001	0.010	0.019	(4)	0.001	----	0.001	(5)	0.008	----	0.019	(6)	0.001	0.004	0.004
1985	(17)	0.000	0.008	0.009	(5)	0.000	----	0.001	(6)	0.004	0.009	0.009	(6)	0.000	0.002	0.002
1986	(21)	0.001	0.007	0.009	(11)	0.001	0.002	0.002	(5)	0.006	----	0.009	(5)	0.000	----	0.004
1987	(22)	0.001	0.006	0.010	(12)	0.001	0.001	0.002	(5)	0.006	----	0.010	(5)	0.001	----	0.006
1988	(20)	0.002	0.008	0.009	(11)	0.001	0.002	0.002	(5)	0.006	----	0.008	(4)	0.001	----	0.009
1989	(14)	0.001	0.005	0.006	(6)	0.001	0.002	0.002	(4)	0.004	----	0.006	(4)	0.001	----	0.004
1990	(17)	0.001	0.005	0.014	(8)	0.001	0.001	0.001	(4)	0.005	----	0.014	(5)	0.001	----	0.004
1991	(20)	0.001	0.004	0.004	(10)	0.001	0.002	0.002	(5)	0.003	----	0.004	(5)	0.001	----	0.001
1992	(19)	0.001	0.004	0.004	(10)	0.001	0.003	0.003	(4)	0.004	----	0.004	(5)	0.000	----	0.001
1993	(18)	0.001	0.003	0.008	(9)	0.001	0.001	0.001	(4)	0.003	----	0.008	(5)	0.000	----	0.001
1994	(20)	0.001	0.004	0.005	(10)	0.001	0.002	0.002	(5)	0.003	----	0.005	(5)	0.001	----	0.001
Cd: Annual mean, micrograms/cubic meter																
1978	(104)	0.002	0.008	0.022	(60)	0.002	0.004	0.022	(15)	0.008	0.011	0.011	(29)	0.002	0.010	0.016
1979	(85)	0.002	0.005	0.011	(38)	0.002	0.003	0.005	(17)	0.005	0.009	0.011	(30)	0.002	0.005	0.006
1980	(73)	0.001	0.005	0.013	(28)	0.000	0.002	0.004	(17)	0.005	0.008	0.013	(28)	0.000	0.004	0.009
1981	(0)	----	----	----	(0)	----	----	----	(0)	----	----	----	(0)	----	----	----
1982	(12)	0.001	0.009	0.009	(2)	0.001	----	0.001	(4)	0.009	----	0.009	(6)	0.000	0.003	0.003
1983	(15)	0.000	0.006	0.026	(4)	0.000	----	0.000	(5)	0.005	----	0.026	(6)	0.000	0.002	0.002
1984	(15)	0.002	0.005	0.019	(4)	0.001	----	0.001	(5)	0.005	----	0.019	(6)	0.002	0.004	0.004
1985	(17)	0.001	0.006	0.016	(5)	0.000	----	0.001	(6)	0.005	0.015	0.016	(6)	0.001	0.002	0.002
1986	(36)	0.003	0.007	0.021	(26)	0.003	0.004	0.006	(5)	0.009	----	0.021	(5)	0.001	----	0.001
1987	(39)	0.002	0.009	0.036	(29)	0.002	0.004	0.005	(5)	0.010	----	0.036	(5)	0.001	----	0.002
1988	(27)	0.003	0.005	0.020	(18)	0.003	0.004	0.005	(5)	0.005	----	0.020	(4)	0.000	----	0.000
1989	(15)	0.000	0.005	0.013	(7)	0.000	0.004	0.004	(4)	0.005	----	0.013	(4)	0.000	----	0.000
1990	(17)	0.002	0.007	0.011	(8)	0.002	0.006	0.008	(4)	0.004	----	0.011	(5)	0.000	----	0.001
1991	(20)	0.001	0.003	0.016	(10)	0.001	0.003	0.003	(5)	0.003	----	0.016	(5)	0.000	----	0.000
1992	(19)	0.001	0.005	0.013	(10)	0.001	0.005	0.005	(4)	0.002	----	0.013	(5)	0.000	----	0.001
1993	(18)	0.001	0.005	0.006	(9)	0.001	0.005	0.005	(4)	0.001	----	0.006	(5)	0.000	----	0.000
1994	(20)	0.001	0.004	0.009	(10)	0.001	0.003	0.003	(5)	0.002	----	0.009	(5)	0.000	----	0.000

Table 1. Summary of Pollutant Concentration Distributions over Sampling Stations In Four Geographic Areas (continued).

	Statewide				Chicago area				Metro-East area				Remainder of state			
Year	(n)*	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum
Cr: Annual mean, micrograms/cubic meter																
1985	(17)	0.001	0.011	0.018	(5)	0.001	—	0.004	(6)	0.005	0.017	0.018	(6)	0.001	0.002	0.002
1986	(36)	0.010	0.027	0.041	(26)	0.010	0.028	0.041	(5)	0.009	—	0.019	(5)	0.002	—	0.003
1987	(39)	0.006	0.020	0.032	(29)	0.007	0.020	0.022	(5)	0.016	—	0.032	(5)	0.002	—	0.003
1988	(27)	0.005	0.021	0.028	(18)	0.005	0.020	0.024	(5)	0.015	—	0.028	(4)	0.002	—	0.003
1989	(15)	0.004	0.016	0.018	(7)	0.005	0.014	0.016	(4)	0.010	—	0.018	(4)	0.002	—	0.003
1990	(17)	0.001	0.015	0.015	(8)	0.004	0.015	0.015	(4)	0.006	—	0.013	(5)	0.000	—	0.000
1991	(20)	0.000	0.008	0.010	(10)	0.002	0.010	0.010	(5)	0.000	—	0.007	(5)	0.000	—	0.000
1992	(19)	0.000	0.009	0.012	(10)	0.003	0.011	0.012	(4)	0.003	—	0.006	(5)	0.000	—	0.000
1993	(18)	0.002	0.010	0.011	(9)	0.005	0.011	0.011	(4)	0.003	—	0.008	(5)	0.000	—	0.001
1994	(20)	0.001	0.009	0.011	(10)	0.003	0.010	0.011	(5)	0.005	—	0.009	(5)	0.000	—	0.000
Fe: Annual mean, micrograms/cubic meter																
1978	(124)	0.85	1.93	10.58	(80)	0.85	1.65	4.82	(15)	1.41	7.70	10.58	(29)	0.74	1.61	2.37
1979	(104)	0.99	1.92	15.03	(58)	0.99	1.66	3.13	(16)	1.79	10.36	15.03	(30)	0.81	1.34	1.59
1980	(93)	0.68	1.28	6.93	(48)	0.71	1.13	1.32	(17)	1.11	4.23	6.93	(28)	0.54	1.09	1.34
1981	(86)	0.61	1.03	10.59	(45)	0.60	0.84	1.24	(15)	1.04	6.34	10.59	(26)	0.58	0.86	0.92
1982	(30)	0.60	1.11	3.12	(20)	0.60	0.86	0.91	(4)	1.37	—	3.12	(6)	0.51	0.68	0.69
1983	(46)	0.81	1.29	4.00	(35)	0.81	1.12	2.18	(5)	1.36	—	4.00	(6)	0.64	0.84	0.84
1984	(47)	0.69	1.25	3.18	(36)	0.69	1.08	2.45	(5)	1.27	—	3.18	(6)	0.50	0.94	0.97
1985	(48)	0.64	1.42	5.81	(36)	0.64	1.05	3.81	(6)	1.44	5.46	5.81	(6)	0.38	0.68	0.70
1986	(36)	0.72	1.65	7.54	(26)	0.72	1.31	1.68	(5)	2.23	—	7.54	(5)	0.44	—	0.75
1987	(39)	0.84	1.74	7.65	(29)	0.82	1.26	2.00	(5)	2.55	—	7.65	(5)	0.53	—	0.87
1988	(27)	0.83	2.58	8.97	(18)	0.86	1.42	2.11	(5)	2.70	—	8.97	(4)	0.57	—	0.80
1989	(16)	1.10	2.49	5.41	(8)	1.25	2.16	2.35	(4)	2.15	—	5.41	(4)	0.51	—	0.78
1990	(17)	0.98	2.26	5.34	(8)	1.27	2.10	2.28	(4)	2.15	—	5.34	(5)	0.60	—	0.82
1991	(20)	0.72	1.99	2.22	(10)	1.08	1.88	2.22	(5)	0.88	—	2.07	(5)	0.48	—	0.70
1992	(19)	0.86	2.06	2.59	(10)	1.19	1.94	2.18	(4)	1.39	—	2.59	(5)	0.54	—	0.73
1993	(18)	0.93	2.24	2.46	(9)	1.18	2.18	2.40	(4)	1.40	—	2.46	(5)	0.54	—	0.60
1994	(20)	0.96	2.72	3.74	(10)	1.30	2.42	2.98	(5)	1.89	—	3.74	(5)	0.57	—	0.71

Table 1. Summary of Pollutant Concentration Distributions over Sampling Stations In Four Geographic Areas (continued).

	Statewide				Chicago area				Metro-East area				Remainder of state			
Year	(n)*	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum
Mn: Annual mean, micrograms/cubic meter																
1978	(124)	0.044	0.118	1.335	(80)	0.041	0.079	0.294	(15)	0.108	0.428	1.335	(29)	0.059	0.113	0.129
1979	(105)	0.056	0.133	1.268	(58)	0.054	0.085	0.367	(17)	0.133	0.510	1.268	(30)	0.058	0.092	0.129
1980	(93)	0.038	0.103	0.737	(48)	0.036	0.061	0.680	(17)	0.083	0.300	0.737	(28)	0.040	0.086	0.137
1981	(87)	0.038	0.089	1.126	(46)	0.035	0.060	0.420	(15)	0.077	0.337	1.126	(26)	0.041	0.066	0.089
1982	(30)	0.035	0.079	0.319	(20)	0.033	0.057	0.080	(4)	0.085	—	0.319	(6)	0.034	0.038	0.038
1983	(46)	0.045	0.142	0.316	(35)	0.046	0.138	0.303	(5)	0.072	—	0.316	(6)	0.033	0.043	0.043
1984	(47)	0.043	0.150	0.320	(36)	0.048	0.123	0.320	(5)	0.070	—	0.222	(6)	0.032	0.037	0.037
1985	(49)	0.045	0.176	0.575	(37)	0.045	0.122	0.575	(6)	0.104	0.374	0.390	(6)	0.030	0.064	0.067
1986	(36)	0.042	0.191	0.458	(26)	0.042	0.075	0.281	(5)	0.197	—	0.458	(5)	0.029	—	0.033
1987	(39)	0.043	0.149	0.641	(29)	0.043	0.111	0.167	(5)	0.271	—	0.641	(5)	0.037	—	0.041
1988	(28)	0.044	0.247	0.602	(19)	0.041	0.101	0.180	(5)	0.276	—	0.602	(4)	0.036	—	0.046
1989	(16)	0.048	0.237	0.528	(8)	0.048	0.164	0.193	(4)	0.219	—	0.528	(4)	0.032	—	0.035
1990	(17)	0.047	0.233	0.670	(8)	0.056	0.232	0.234	(4)	0.213	—	0.670	(5)	0.036	—	0.047
1991	(20)	0.037	0.194	0.202	(10)	0.042	0.176	0.193	(5)	0.044	—	0.202	(5)	0.027	—	0.033
1992	(19)	0.035	0.211	0.396	(10)	0.043	0.282	0.396	(4)	0.097	—	0.239	(5)	0.027	—	0.030
1993	(18)	0.036	0.173	0.255	(9)	0.060	0.170	0.182	(4)	0.098	—	0.255	(5)	0.025	—	0.028
1994	(20)	0.042	0.212	0.280	(10)	0.054	0.191	0.199	(5)	0.148	—	0.280	(5)	0.030	—	0.031
Ni: Annual mean, micrograms/cubic meter																
1984	(15)	0.002	0.007	0.007	(4)	0.002	—	0.002	(5)	0.006	—	0.007	(6)	0.002	0.005	0.005
1985	(17)	0.001	0.005	0.007	(5)	0.001	—	0.001	(6)	0.004	0.007	0.007	(6)	0.000	0.004	0.004
1986	(36)	0.007	0.012	0.014	(26)	0.007	0.012	0.014	(5)	0.004	—	0.009	(5)	0.002	—	0.005
1987	(39)	0.005	0.009	0.018	(29)	0.005	0.009	0.009	(5)	0.006	—	0.018	(5)	0.002	—	0.005
1988	(27)	0.005	0.013	0.021	(18)	0.007	0.009	0.014	(5)	0.005	—	0.021	(4)	0.002	—	0.003
1989	(15)	0.003	0.011	0.022	(7)	0.004	0.020	0.022	(4)	0.005	—	0.008	(4)	0.001	—	0.003
1990	(17)	0.003	0.007	0.009	(8)	0.005	0.008	0.009	(4)	0.003	—	0.007	(5)	0.001	—	0.003
1991	(20)	0.002	0.008	0.010	(10)	0.004	0.009	0.010	(5)	0.002	—	0.006	(5)	0.001	—	0.002
1992	(19)	0.006	0.011	0.013	(10)	0.008	0.012	0.013	(4)	0.007	—	0.010	(5)	0.003	—	0.006
1993	(18)	0.005	0.015	0.016	(9)	0.006	0.016	0.016	(4)	0.006	—	0.008	(5)	0.003	—	0.007
1994	(20)	0.008	0.011	0.012	(10)	0.008	0.010	0.010	(5)	0.008	—	0.011	(5)	0.007	—	0.012

Table 1. Summary of Pollutant Concentration Distributions over Sampling Stations In Four Geographic Areas (concluded).

	Statewide				Chicago area				Metro-East area				Remainder of state			
Year	(n)*	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum	(n)	Median	90th pctile	Maxi-mum
PM10: Annual mean, mlcrograms/cublc meter																
1987	(16)	40	57	70	(7)	36	43	44	(5)	49	—	70	(4)	35	—	57
1988	(16)	42	60	69	(7)	40	46	47	(5)	43	—	69	(4)	32	—	53
1989	(23)	40	62	77	(12)	40	45	48	(7)	45	74	77	(4)	35	—	64
1990	(36)	37	45	82	(15)	37	45	45	(10)	39	65	82	(11)	27	41	51
1991	(33)	34	44	57	(13)	34	43	46	(8)	37	55	57	(12)	26	38	43
1992	(33)	33	42	50	(13)	33	36	42	(9)	41	50	50	(11)	31	39	40
1993	(34)	28	37	47	(13)	30	39	47	(9)	29	42	44	(12)	22	28	29
1994	(38)	33	42	46	(17)	36	44	46	(8)	35	43	45	(13)	22	30	35
PM10: Maximum 24-hr mean, mlcrograms/cublc meter																
1987	(23)	95	189	210	(14)	94	142	186	(5)	109	—	201	(4)	95	—	210
1988	(21)	104	205	365	(10)	103	283	365	(5)	120	—	212	(6)	68	152	154
1989	(36)	99	193	311	(16)	100	135	225	(9)	123	200	203	(11)	85	223	311
1990	(37)	98	184	295	(16)	137	158	191	(10)	103	263	295	(11)	72	143	202
1991	(38)	81	149	194	(16)	82	130	186	(9)	90	162	167	(13)	58	108	194
1992	(38)	83	139	217	(16)	82	138	199	(9)	91	193	217	(13)	73	120	138
1993	(38)	72	125	192	(16)	81	137	156	(9)	80	162	192	(13)	51	123	126
1994	(39)	87	149	238	(17)	121	158	238	(9)	87	176	208	(13)	68	91	108

Notes:

* (n) is the number of sampling sites in the state/region with valid data.

** — indicates that the data were inadequate to compute a value. No 90th percentile values were computed for (n)<6.

Table 2. Mean Annual Change as a Percent of Overall Mean Regional Concentrations, 1978-1994. (Trend Significance Based on Nonparametrlc Mann-Kendall Test. Values in Boldface Are Significant at 1% Level, Other Values at 5% Level.)

Species	Observation	Trend units (per yr)	Statewide Median	Statewide 90th pctile	Statewide Maxi-mum	Chicago area Median	Chicago area 90th pctile	Chicago area Maxi-mum	Metro-East area Median	Metro-East area 90th pctile	Metro-East area Maxi-mum	Remainder of state Median	Remainder of state 90th pctile	Remainder of state Maxi-mum
CO	Maximum 1-hr mean	ppm	-3.05	-4.32	-4.63	-2.25	-5.74	-5.80	-4.01	----*	-6.25	-3.32	----	-2.43
CO	Maximum 8-hr mean	ppm	-3.12	-3.38	-4.19	-2.33	-4.94	-5.31	-4.55	----	-6.19	-3.60	----	-1.84
Pb	Annual mean	ug/m3	-16.29	-8.88	-12.54	-16.63	-11.59	-12.68	-11.53	-9.40	-12.59	-19.42	----	-19.67
NO2	Maximum 1-hr mean	ppm	-3.71	-8.89	-5.76	-4.63	-8.84	-5.76	-5.60	----	-6.13	----	----	----
NO2	Maximum 24-hr mean	ppm	-4.00	-6.21	-7.55	-3.87	-6.27	-7.55	-3.04	----	-5.49	----	----	----
NO2	Annual mean	ppm	-4.90	-3.90	-3.95	-4.51	-3.74	-3.95	-0.12	----	-0.37	----	----	----
O3	Maximum 1-hr mean	ppm	-1.40	-2.41	-2.39	-1.74	-3.03	-2.59	-1.58	-1.85	-1.86	n.s.	-0.98	-1.43
SO2	Maximum 3-hr mean	ppm	n.s.*	n.s.	n.s.	-3.21	-2.50	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
SO2	Maximum 24-hr mean	ppm	-2.04	n.s.	n.s.	-3.77	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
SO2	Annual mean	ppm	-2.96	-2.82	-3.71	-3.48	-3.75	-3.93	-4.36	-6.84	-4.32	n.s.	n.s.	n.s.
TSP	Maximum 24-hr mean	ug/m3	n.s.	n.s.	-4.90	n.s.	n.s.	-4.08	-2.01	-5.36	-7.98	-2.00	n.s.	n.s.
TSP	Annual geom mean	ug/m3	n.s.	n.s.	-4.71	n.s.	n.s.	-2.15	n.s.	n.s.	-5.04	-2.49	-0.75	-3.99
PM10	Annual mean	ug/m3	-4.26	-6.53	-6.97	-2.04	n.s.	n.s.	-5.53	-15.77	-7.43	-6.28	----	-8.65
PM10	Maximum 24-hr mean	ug/m3	n.s.	-5.84	n.s.	n.s.	n.s.	n.s.	-5.10	n.s.	n.s.	-5.33	-11.52	-8.76
NO3	Annual mean	ug/m3	-0.83	-1.29	-1.89	n.s.	-1.24	-1.89	-1.06	----	-1.54	n.s.	----	n.s.
SO4	Annual mean	ug/m3	-0.93	-1.19	-1.97	-1.03	-1.09	-2.21	-0.87	----	-2.01	-1.10	----	-2.44
As	Annual mean	ug/m3	-7.08	-4.95	-12.27	-6.95	-14.12	-21.57	-4.75	----	-12.31	-9.44	----	-5.21
Cd	Annual mean	ug/m3	n.s.	-3.28	n.s.	n.s.	n.s.	n.s.	-7.15	----	n.s.	-19.43	----	-26.54
Cr	Annual mean	ug/m3	-19.65	-8.57	-11.89	n.s.	-15.09	n.s.	n.s.	----	-12.22	-22.35	----	----
Fe	Annual mean	ug/m3	1.29	3.56	-7.68	3.68	4.26	n.s.	n.s.	----	-7.72	n.s.	----	-7.13
Mn	Annual mean	ug/m3	n.s.	4.44	-8.84	1.65	7.34	n.s.	n.s.	----	-9.49	-4.33	----	-10.41
Ni	Annual mean	ug/m3	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	----	n.s.	n.s.	----	n.s.

Notes:

* — indicates that the data were inadequate to compute a value. n.s. indicates that the computed trend was not significant at the 5% level. No 90th percentile values were computed for (n)<6.

Correlations of Time Trends between Regions

Table 3 shows Pearson correlation coefficients between subregions of the state for medians, 90th percentile values, and maximum values of each pollutant data set. The hypothesis behind this table is that concentrations in separate regions should tend to be correlated if the *same influence* on concentrations (e.g., the same source, or the same kinds of changes in different sources) affected both of them. Since the regions are separated geographically, high correlations could indicate that *distant* sources or spatially uniform federal emission controls are dominant, while low correlations could suggest that *local* sources are more important or that application or effectiveness of control measures is spotty.

Time Trends at Individual Long Duration Sites

For most pollutant species, the number of Illinois measurement sites has declined substantially during the data period (1978-1994). For example, the number of sites for which Pb data were reported dropped from 93 sites in 1979 to 26 sites in 1994. Since the main objective of the monitoring is to detect violations of the standards, when sites must be closed it seems likely that those considered least likely to detect violations (i.e., the "cleanest" sites) would be closed first. Thus, closing a large number of sites over a period of years could bias the regional median value of some pollutant measurement (e.g., annual mean concentration) relative to what the median would have been if all the original sites were still operating. Thus, a *trend* of annual median values in a region could also be biased toward a more positive (or less negative) value. Trends at long duration sites were computed and compared to regional trends as an indication of possible serious bias due to closing of sampling sites. It must be noted that the comparison provided here is only *qualitative;* it is not a rigorous quantitative statistical comparison. If it is in fact possible to do such a statistical comparison between 1) a trend in regional median values and 2) trends at several individual sites with records of possibly varying length, it is well beyond the scope of this work. From the comparisons of regional and individual site trends, one should look for *marked* differences in trends, and consider any found as warnings of possible biases in regional trends.

Regional Trend Plots

Trends in individual pollutants were examined, using the trend results in table 2, the correlations in table 3, and the tables of trend results for individual long-duration sites, along with plots of concentrations vs. time. Each figure shows results for up to four geographical areas, depending on whether the number of sampling sites in the region was adequate. Each figure shows results for the entire state and the Chicago area, which is the portion of AQCR 67 in Illinois. Most figures also show results for the Metro-East area on the Illinois side of the Mississippi River across from St. Louis. This is the Illinois portion of AQCR 70. The fourth geographic region, shown in most figures, is the "Remainder" of the state. This region includes all areas of the state other than the Chicago and the Metro-East areas; however, that does not imply a uniform distribution of sampling stations, nor does it imply *rural* sampling locations. Samplers

Table 3. Pearson Correlation Coefficients between Regions for Medians, 90th Percentile Values, and Maximum Values. (Correlation Coefficients > 0.700 Are in Bold.)

	Medians			90th percentile values			Maximums		
	Chicago	Metro-East	Remainder	Chicago	Metro-East	Remainder	Chicago	Metro-East	Remainder
CO: maximum 1-hr mean									
Chicago	1			----*			1		
Metro-East	0.537	1		----	----		**0.859**	1	
Remainder	0.619	0.639	1	----	----	----	0.435	0.505	1
CO: maximum 8-hr mean									
Chicago	1			----			1		
Metro-East	0.428	1		----	----		0.671	1	
Remainder	0.567	0.587	1	----	----	----	0.363	0.424	1
Pb: maximum 1-hr mean									
Chicago	1			1			1		
Metro-East	**0.866**	1		0.554	1		0.675	1	
Remainder	**0.973**	**0.858**	1	**0.968**	**0.989**	1	**0.717**	0.387	1
NO2: maximum 1-hr mean									
Chicago	1			----			1		
Metro-East	0.437	1		----	----		0.484	1	
Remainder	----	----	----	----	----	----	----	----	----
NO2: maximum 24-hr mean									
Chicago	1			----			1		
Metro-East	0.482	1		----	----		**0.778**	1	
Remainder	----	----	----	----	----	----	----	----	----
NO2: annual mean									
Chicago	1			----			1		
Metro-East	**-0.704**	1		----	----		0.073	1	
Remainder	----	----	----	----	----	----	----	----	----
O3: maximum 1-hr mean									
Chicago	1			1			1		
Metro-East	0.612	1		**0.788**	1		0.594	1	
Remainder	**0.726**	0.669	1	0.328	0.194	1	0.598	0.646	1
SO2: maximum 3-hr mean									
Chicago	1			1			1		
Metro-East	0.002	1		0.041	1		-0.291	1	
Remainder	-0.148	0.105	1	-0.035	0.359	1	0.013	0.248	1
SO2: maximum 24-hr mean									
Chicago	1			1			1		
Metro-East	0.038	1		-0.116	1		-0.267	1	
Remainder	0.067	0.447	1	-0.117	0.336	1	0.048	0.478	1
SO2: annual mean									
Chicago	1			1			1		
Metro-East	0.596	1		0.671	1		0.628	1	
Remainder	0.384	0.547	1	0.433	0.304	1	0.516	0.454	1

Table 3. Pearson Correlation Coefficients (continued).

	Medians			90th percentile values			Maximums		
	Chicago	Metro-East	Remainder	Chicago	Metro-East	Remainder	Chicago	Metro-East	Remainder
TSP: maximum 24-hr mean									
Chicago	1			1			1		
Metro-East	0.151	1		-0.008	1		0.318	1	
Remainder	**0.876**	0.248	1	**0.705**	-0.083	1	0.641	0.021	1
TSP: annual mean									
Chicago	1			1			1		
Metro-East	**0.786**	1		**0.761**	1		**0.786**	1	
Remainder	**0.705**	**0.801**	1	0.483	**0.837**	1	**0.805**	**0.894**	1
PM10: maximum 24-hr mean									
Chicago	1			1			1		
Metro-East	0.242	1		0.581	1		0.033	1	
Remainder	0.207	0.667	1	0.097	0.355	1	-0.076	0.051	1
PM10: annual mean									
Chicago	1			1			1		
Metro-East	0.655	1		0.558	1		0.153	1	
Remainder	0.593	**0.956**	1	0.104	**0.876**	1	0.154	**0.895**	1
NO3: annual mean									
Chicago	1			----			1		
Metro-East	0.326	1		----	----		0.640	1	
Remainder	0.243	**0.847**	1	----	----	----	0.629	**0.867**	1
SO4: annual mean									
Chicago	1			----			1		
Metro-East	0.675	1		----	----		0.620	1	
Remainder	**0.845**	**0.828**	1	----	----	----	0.636	**0.954**	1
As: annual mean									
Chicago	1			----			1		
Metro-East	0.304	1		----	----		0.623	1	
Remainder	**0.806**	0.316	1	----	----	----	0.064	0.341	1
Cd: annual mean									
Chicago	1			----			1		
Metro-East	0.399	1		----	----		-0.178	1	
Remainder	0.319	0.471	1	----	----	----	0.692	-0.133	1
Cr: annual mean									
Chicago	1			----			1		
Metro-East	0.607	1		----	----		0.499	1	
Remainder	**0.707**	**0.881**	1	----	----	----	0.590	**0.849**	1
Fe: annual mean									
Chicago	1			----			1		
Metro-East	0.234	1		----	----		0.249	1	
Remainder	0.194	0.029	1	----	----	----	0.564	0.645	1

Table 3. Pearson Correlation Coefficients (concluded).

	Medians			90th percentile values			Maximums		
	Chicago	Metro-East	Remainder	Chicago	Metro-East	Remainder	Chicago	Metro-East	Remainder
Mn: annual mean									
Chicago	1			----			1		
Metro-East	0.183	1		----	----		0.255	1	
Remainder	-0.110	0.047	1	----	----	----	0.619	0.832	1
Ni: annual mean									
Chicago	1			----			1		
Metro-East	0.538	1		----	----		0.165	1	
Remainder	0.696	0.773	1	----	----	----	-0.036	0.045	1

Note:
* — indicates that one or both data sets were inadequate for computing a meaningful correlation coefficient.

in the Remainder region tend to be in medium-sized cities, such as Rockford, Peoria, Rock Island, Springfield, and Decatur, and in smaller cities, such as Carbondale, Mt. Vernon, Quincy, and Champaign.

Carbon Monoxide (CO). Regional results for CO are shown in tables 2 and 3 and figures 1 and 2. Table 2 shows downward trends for medians, 90th percentiles, and maximum values of both maximum 1-hr means and maximum 8-hr means in all areas of the state where there were sufficient data to test. All of the downward trends were significant at the 1% level, except for one that was significant at the *5%* level. The mean percent annual change ranged from about -2% to -6% of the overall mean over sites and years for each region. The figures show the trends as well, and the actual probabilities (p-values) that the trends occurred by chance, based on the Mann-Kendall test. Note that the statistics for the Metro-East area and the Remainder of the state are based on limited numbers of sampling sites. The numbers of sites are shown year by year at the bottom of each plot panel whenever the number of sites (n) was less than six.

The correlation coefficients, r, in table 3 are mostly between 0.4 and 0.7, showing a moderate degree of correlation between regions. The highest correlation is 0.859 for the highest maximum 1-hr mean values between Chicago and the Metro-East area. Those two regions also had the highest correlation, 0.671, for the maximum 8-hr means, and that one was for the highest values as well. The main source of CO is exhaust from motor vehicles, so the sources would be mostly local in both regions. Uniform controls on vehicle emissions and the phase-out of older, high-emission vehicles in all regions simultaneously may account for the moderate positive correlations observed.

Table 4 shows computed trends for individual sites with the longest data records in the Chicago, Metro-East, and Remainder regions, along with trends of each regional median for comparison. In the Chicago area, no significant trends were found at three sites for either maximum 1-hr means or maximum 8-hr means, although significant (1%) downward trends of slightly more than -2% per year in the regional medians were found for both averaging times. These differences are the opposite of what might be expected from bias due to closing sampling sites. However, the individual sites all had data records shorter than the 17-year record for regional medians, which makes it harder to achieve significance, and which missed the early higher concentrations. There was better agreement in the Metro-East and Remainder regions, with *both* the individual sites and the regional medians showing significant downward trends in both 1-hr and 8-hr values.

Lead (Pb). Airborne lead concentrations at all three concentration levels decreased dramatically in all parts of the state (table 2 and figure 3) between 1979 and 1994. This is certainly due in large part to the phase-out of leaded gasoline, beginning in about 1975 (IEPA, 1991). The table and figure show decreasing trends, mostly between -8% and -20% per year, and significant at 1%, for medians, 90th percentiles, and maximums in all areas with adequate data to test. The median concentrations fell more rapidly than the maximums and 90th percentile values

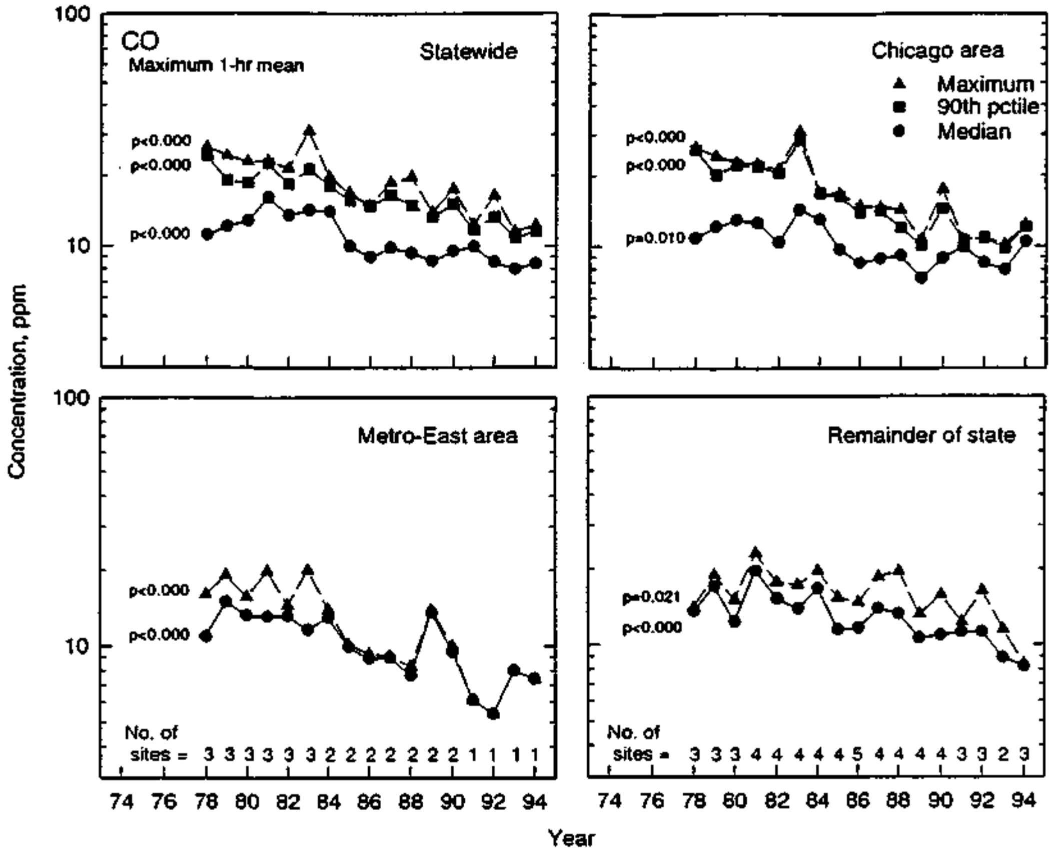

Figure 1. Trends in maximum 1-hr mean CO concentrations in Illinois.

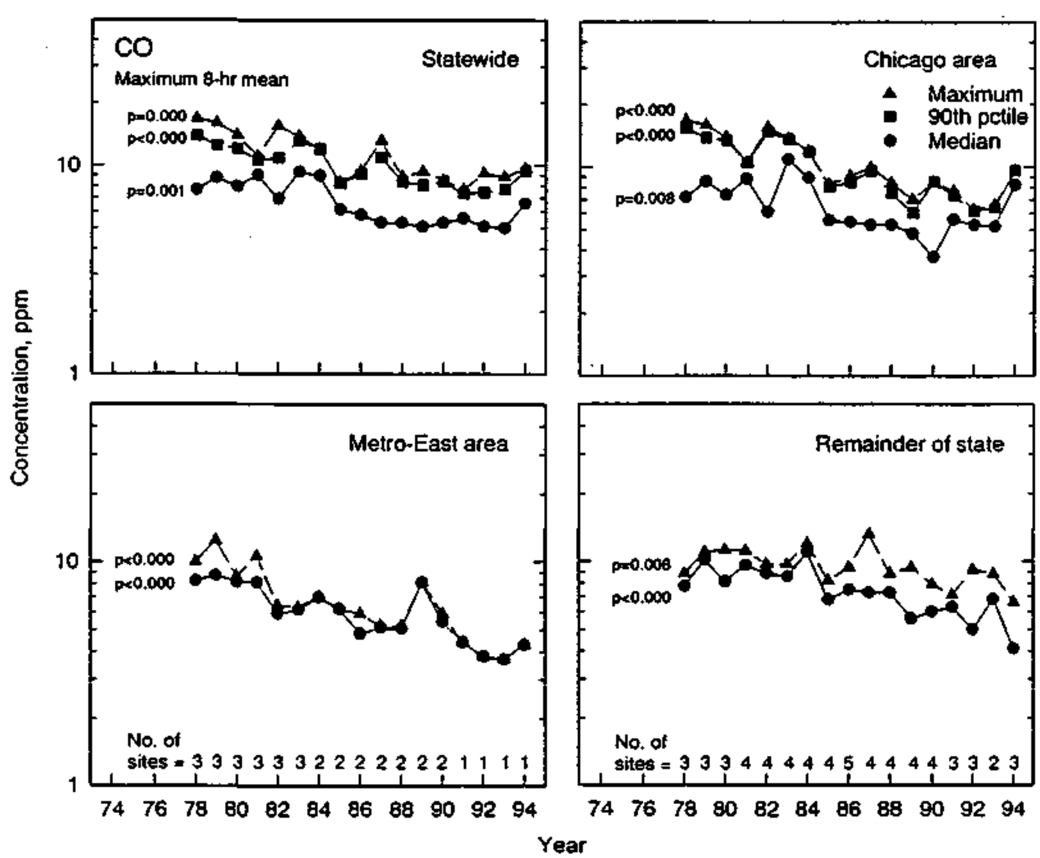

Figure 2. Trends in maximum 8-hr mean CO concentrations in Illinois.

Table 4. Carbon Monoxide Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Maximum 1-hr mean	Maximum 8-hr mean
Chicago	Edgewater	1220037	13	1982	1994	n.s.	n.s.
	Cicero	1340002	12	1983	1994	n.s.	n.s.
	Schiller Park	7040001	10	1985	1994	n.s.	n.s.
	Regional medians		17	1978	1994	**-2.25%**	**-2.33%**
Metro-East	E. St. Louis	2120010	13	1978	1990	-2.48%	-3.32%
	Granite City	2960017	17	1978	1994	**-6.14%**	**-6.19%**
	Regional medians		17	1978	1994	**-4.01%**	**-4.55%**
Remainder	Springfield	7280008	16	1979	1994	**-4.45%**	**-7.30%**
	Rockford	6680011	12	1981	1992	**-6.39%**	**-5.00%**
	Regional medians		17	1978	1994	**-3.32%**	**-3.60%**

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

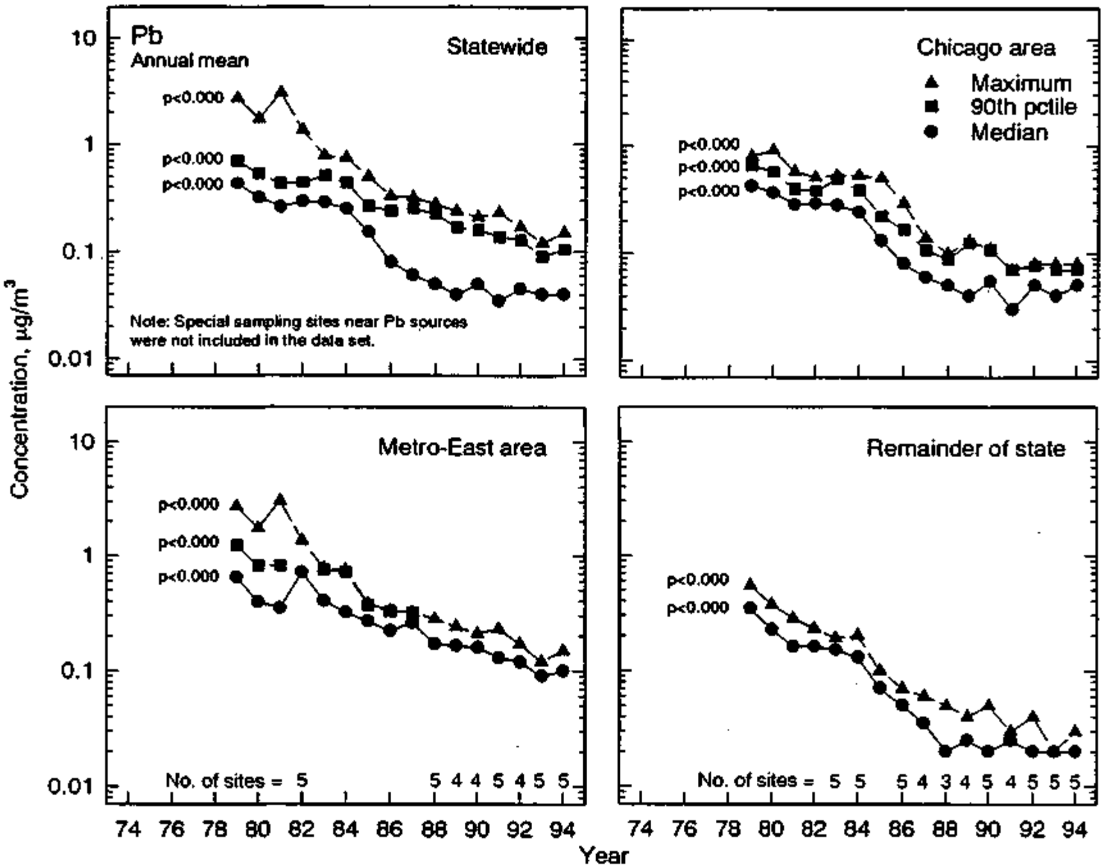

Figure 3. Trends in annual mean Pb in Illinois.

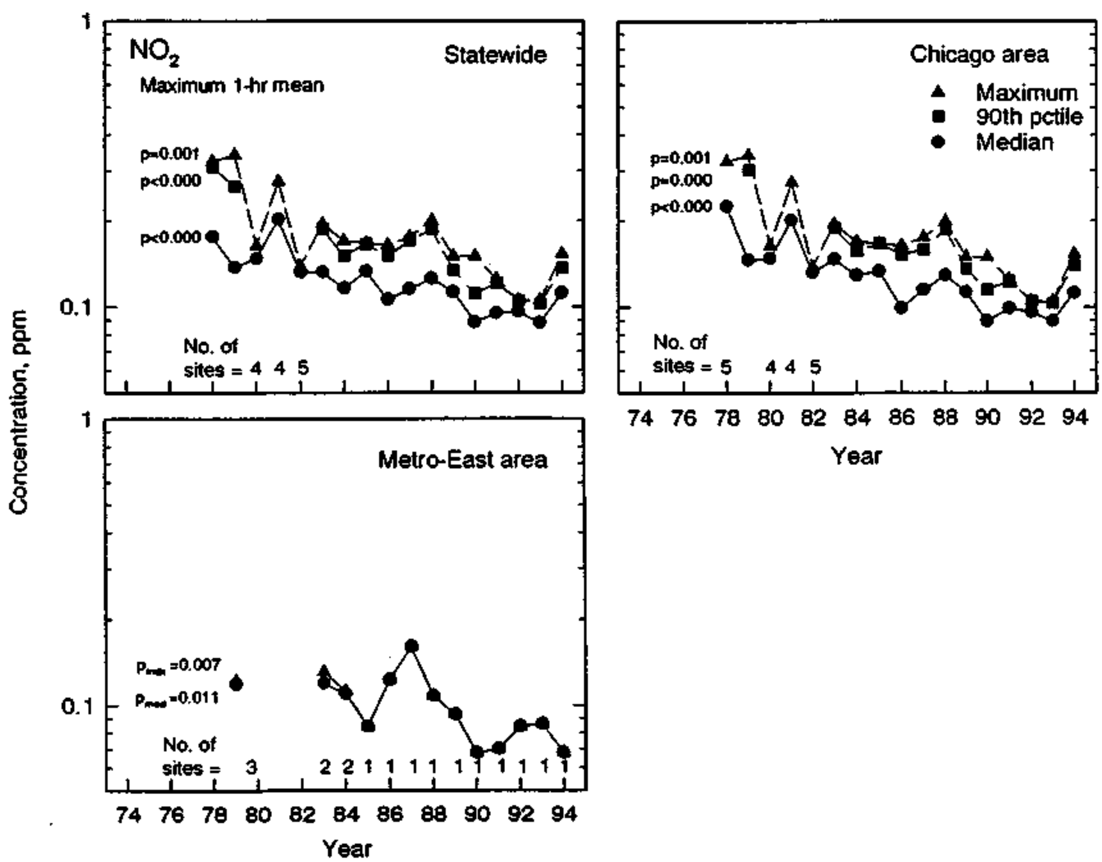

Figure 4. Trends in maximum 1-hr mean NO_2 in Illinois. Data for the "Remainder" area were inadequate to plot.

both statewide and in the Chicago area, but in the Metro-East and in the Remainder of the state, the maximum values had the highest rate of decline.

The correlation coefficients in table 3 show that median Pb concentrations in each region were highly correlated ($r > 0.85$) with those in the other two regions. The 90th percentile Pb concentrations in the "Remainder" region correlated very highly ($r > 0.96$) with those in both of the urban regions, but those in the Chicago and the Metro-East areas correlated only moderately with each other. At the highest concentrations, values for the Chicago region correlated somewhat highly ($r > 0.65$) with those in both of the others. Uniform federal regulations on the phase-out of leaded gasoline explain these high correlations between regions.

Trends at individual sites were not computed for Pb.

Nitrogen Dioxide (NO_2). Trends in airborne concentrations are shown in table 2 and figures 4-6. The number of sites was inadequate to compute 90th percentile values in the Metro-East area, and inadequate for any values in the Remainder of the state. All the computed trends were downward, and were significant at the 1% level statewide and in the Chicago area, as were the trends of the maximum 1-hr and 24-hr means in the Metro-East area. The rest of the computable trends in the Metro-East area were also downward, and were significant at the 5% level.

Most of the rates of decline (table 2) were between -3% and -9% per year. The higher concentrations (90th percentile and maximums) showed the greater rates of decline at the shorter averaging times (1 and 24 hours) in all three regions with results. For the annual mean, however, the median values had somewhat higher rates of decline statewide and in the Chicago area.

Because of the limited number of sites measuring NO_2, it was possible to compute correlations only between the Chicago area and the Metro-East area, which is represented by only one site in most years. For the maximum 1-hr and 24-hr means the correlations ranged from 0.437 to 0.778, showing a moderate correlation between the urban areas. For the annual means, the computed correlation of the regional medians was *negative* (-0.704). Examination of the data (figure 6) shows that the negative relationship was the result of a single year (1979), during which Chicago's highest and the Metro-East's lowest annual means occurred. Because the low measurement was made at a single site, and appears to be unrepresentative of measurements in later years, no significance should be attributed to this negative correlation.

Individual site trends are shown in table 5. In the Chicago area, there is substantial overall agreement between trends at four individual sites and that of the regional median for the 1-hr and 24-hr data, but the regional trend in the annual mean is more negative and more significant than those at any of the four sites. Again, this difference in annual mean trend results is the opposite of what would be expected because of preferential site closings. Further, the data records for the individual sites were somewhat shorter (10-14 years) than the 17-year record used to compute the

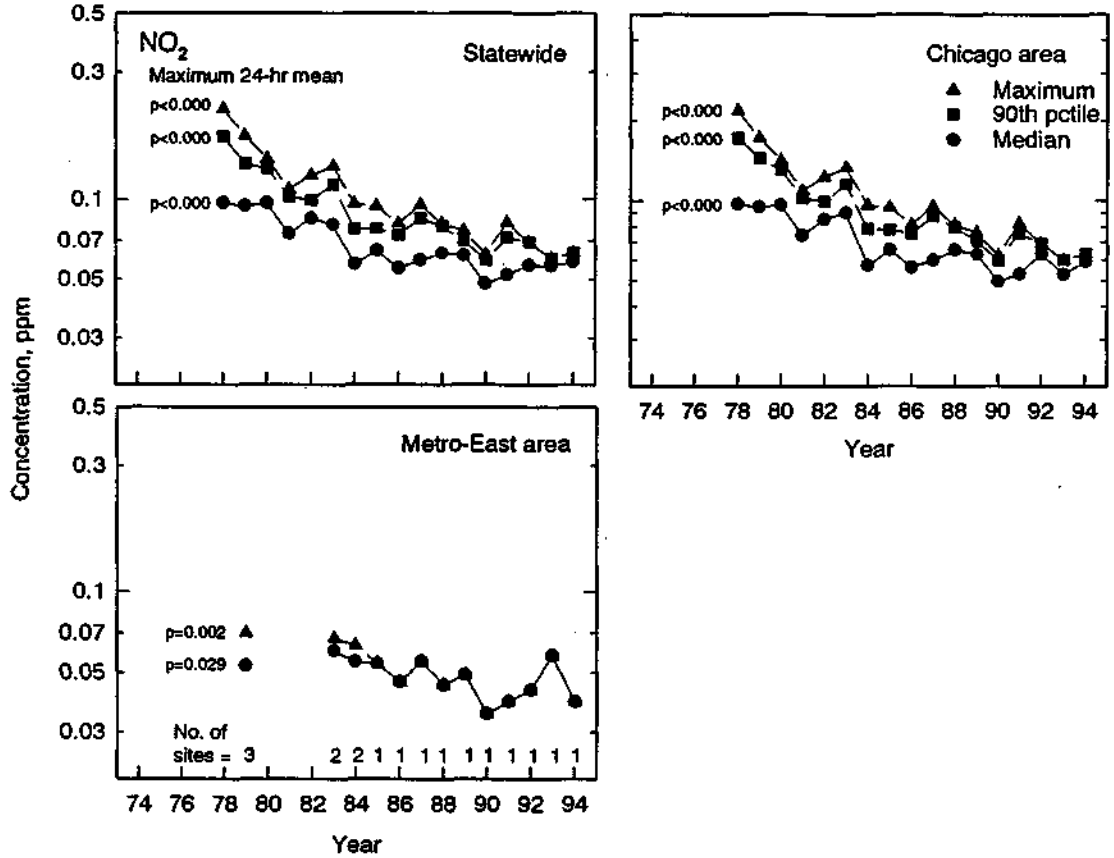

Figure 5. Trends in maximum 24-hr mean NO_2 in Illinois. Data for the "Remainder" area were inadequate to plot.

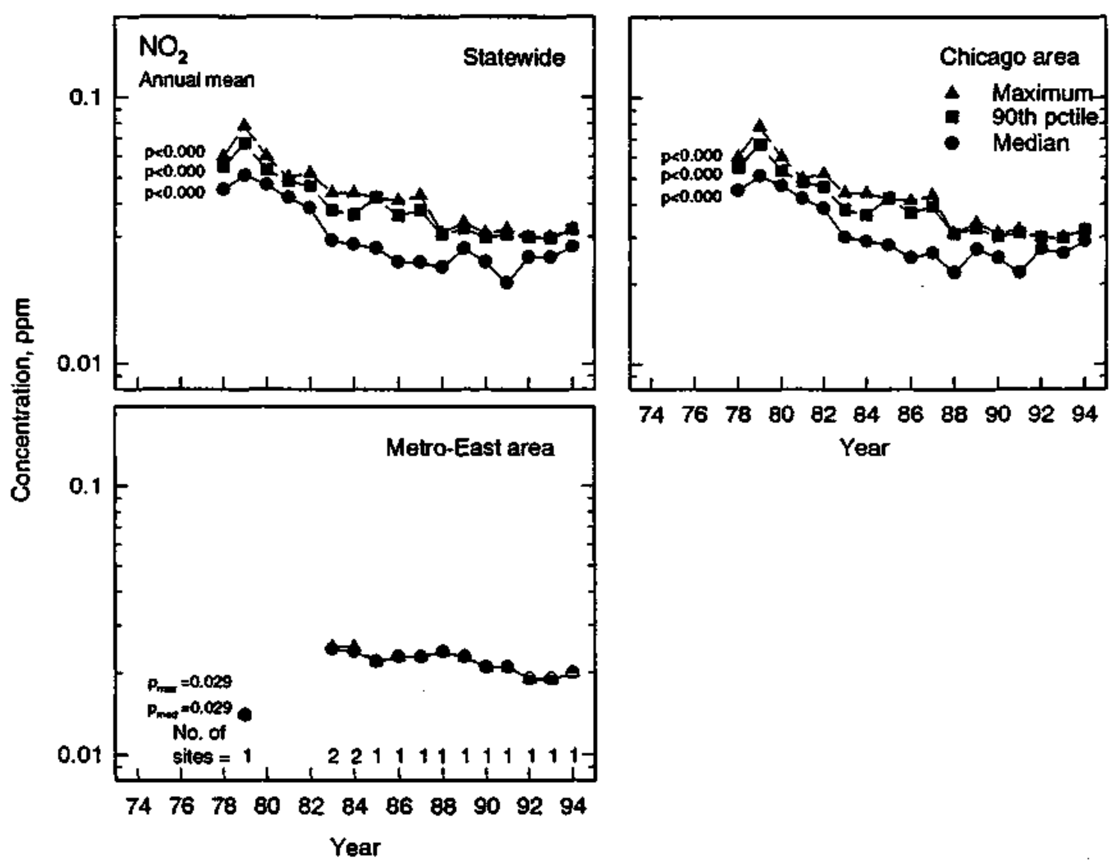

Figure 6. Trends in annual mean NO_2 in Illinois. Data for the "Remainder" area were inadequate to plot.

Table 5. Nitrogen Dioxide Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Maximum 1-hr mean	Maximum 24-hr mean	Annual mean
Chicago	Edgewater	1220037	13	1982	1994	-2.56%	**-4.03%**	n.s.
	Northwestern U.	1220039	14	1981	1994	**-4.92%**	-1.75%	-1.00%
	Cicero	1340002	12	1983	1994	**-5.08%**	-3.44%	N/A
	Schiller Park	7040001	10	1985	1994	n.s.	n.s.	n.s.
	Regional medians		17	1978	1994	**-4.63%**	**-3.87%**	**-4.51%**
Metro-East	E. St. Louis	2120010	13	1978	1990	-4.18%	n.s.	**-1.88%**
	Regional medians		13	1982	1994	-5.60%	-3.04%	-0.12%

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

trend in the regional medians, and figure 6 shows that most of the decline in the regional median occurred before 1984.

In the Metro-East area only one site was suitable for computation of long-term trend (table 5). The regional trends for all three averaging times were downward and significant at the 5% level. Trends at the single East St. Louis site agree as to the direction (downward) of the trend for the 1-hr data and the annual mean, but no significant trend was found for the 24-hr data. There were no long-term sites with adequate NO_2 data in the Remainder region.

Ozone (O3). Table 2 and figure 7 show consistently downward trends in ozone concentrations in Illinois in all areas of the state. Of the 12 trend rates computed for three concentration levels in four geographic areas in table 2,11 were downward and significant at the 5% level or better, eight of these were significant at the 1% level. One computed rate was not significant. The rates of decline ranged from about -1% to -3% per year, with the higher concentrations (90th percentiles and maximums) showing the more rapid declines. Note that these rates were computed on concentrations as observed, unadjusted for meteorological conditions.

Correlations (table 3) ranged mostly between 0.6 and 0.8, except for two computed with 90th percentile values. These values, along with the observed negative trends, suggest that efforts to reduce ozone concentrations have been effective overall, as reflected in correlations of median concentrations, as well as on the highest concentrations, in all areas of the state.

Table 6 shows individual site trends for ozone, which has more individual long duration sampling sites than any other pollutant. For the Chicago region, trends at nine individual sites range from not significant (n.s.) to -3.97% per year significant at the 1% level. The trend in regional medians was -1.74% per year, also significant at the 1% level, which is reasonable agreement, considering that four of the nine single sites show nonsignificant trends. In the Metro-East area, three of four individual sites showed significant trends (all downward), ranging from -1.60% to -2.26% per year, compared to a regional trend of-1.58% per year, which is also reasonable agreement. In the Remainder region, eight of eleven individual sites showed no significant trend, in agreement with the regional result. The other three individual sites showed downward trends of-1.31% to -3.09% per year, all significant at the 5% level.

Sulfur Dioxide (SO_2). Results for SO_2 depart markedly from those presented up to now. Table 2 shows that, with a few exceptions, mostly in the Chicago area, trends in maximum 3-hr and 24-hr means were not significant. The plots of these data in figures 8 and 9 show considerable year-to-year variability but few overall trends. On the other hand, significant (1%) downward trends in annual mean SO_2 occurred statewide and in the two urban areas, but no significant trends in either direction occurred in the Remainder of the state. Trends in the annual mean range mostly from about -2.5% to -4.5% per year, with a maximum value of-6.84% per year for the 90th percentile values in the Metro-East area (table 2).

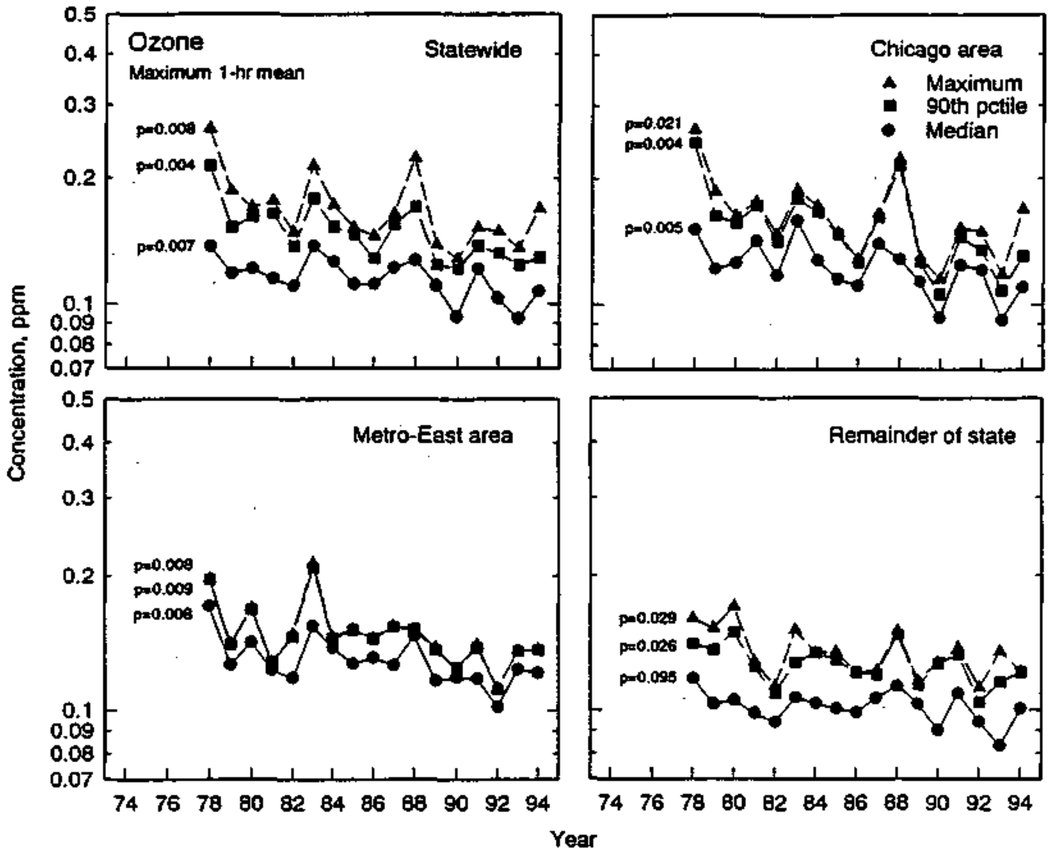

Figure 7. Trends in maximum 1-hr mean ozone in Illinois.

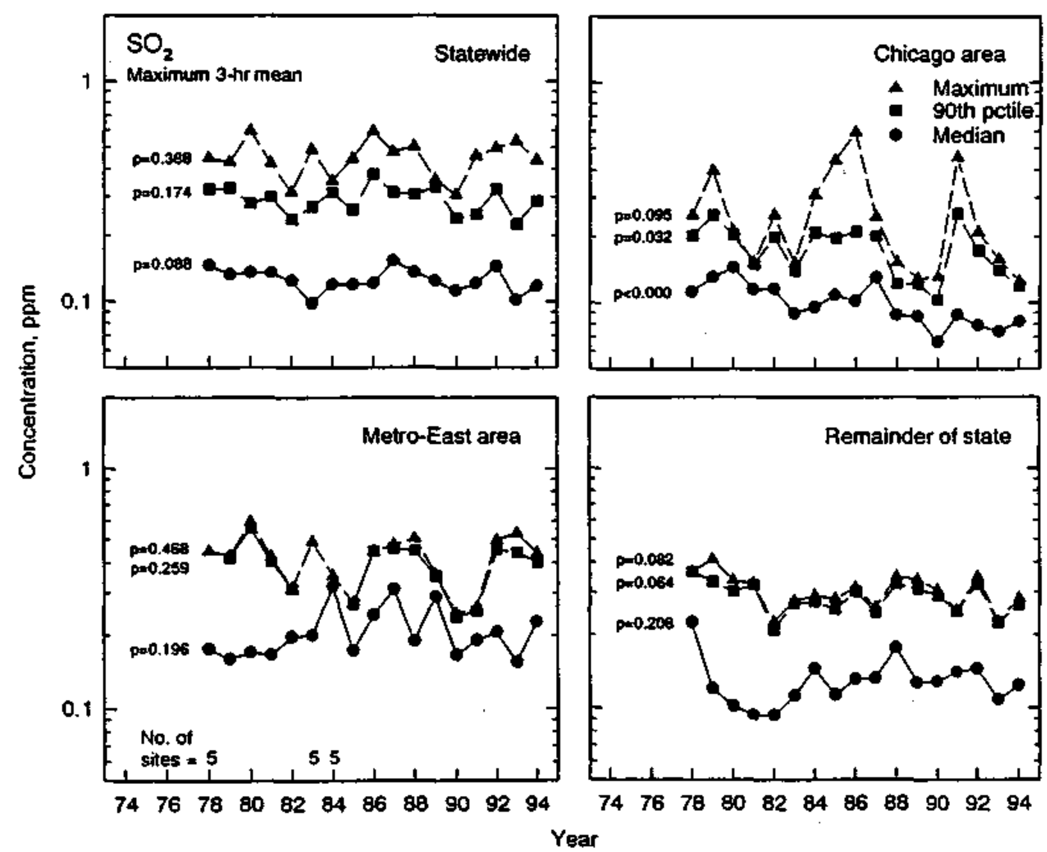

Figure 8. Trends in maximum 3-hr mean SO_2 in Illinois.

Table 6. Ozone Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Maximum 1-hr mean
Chicago	S.E. Police Sta.	1220050	13	1982	1994	n.s.
	Cicero	1340002	12	1983	1994	**-3.97%**
	Evanston	2360002	17	1978	1994	**-2.54%**
	Elgin	2260005	16	1979	1994	n.s.
	Deerfield	1760001	16	1979	1994	-1.68%
	Libertyville	4260001	17	1978	1994	**-3.79%**
	Waukegan	8020002	17	1978	1994	**-3.18%**
	Cary	1020001	15	1980	1994	n.s.
	S. Lockport	8320008	16	1979	1994	n.s.
	Regional medians		17	1978	1994	**-1.74%**
Metro-East	Edwardsville	4680007	17	1978	1994	**-2.26%**
	Maryville	4680009	16	1979	1994	n.s.
	Wood River	8520007	17	1978	1994	-2.06%
	E. St. Louis	2120010	17	1978	1994	-1.60%
	Regional medians		17	1978	1994	**-1.58%**
Remainder	Rockford	6680009	15	1980	1994	n.s.
	Rockford	8400001	16	1979	1994	n.s.
	Effingham	2220001	14	1981	1994	n.s.
	Quincy	6440006	12	1983	1994	n.s.
	Decatur	1740013	12	1983	1994	n.s.
	Nilwood	4640002	14	1981	1994	-1.31%
	Springfield	7280010	15	1980	1994	n.s.
	Peoria	6080024	17	1978	1994	-1.53%
	Peoria Heights	6120001	16	1979	1994	n.s.
	Champaign	1140004	16	1979	1994	n.s.
	Moline	5120003	17	1978	1994	-3.09%
	Regional medians		17	1978	1994	n.s.

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s.=not significant (5% level).

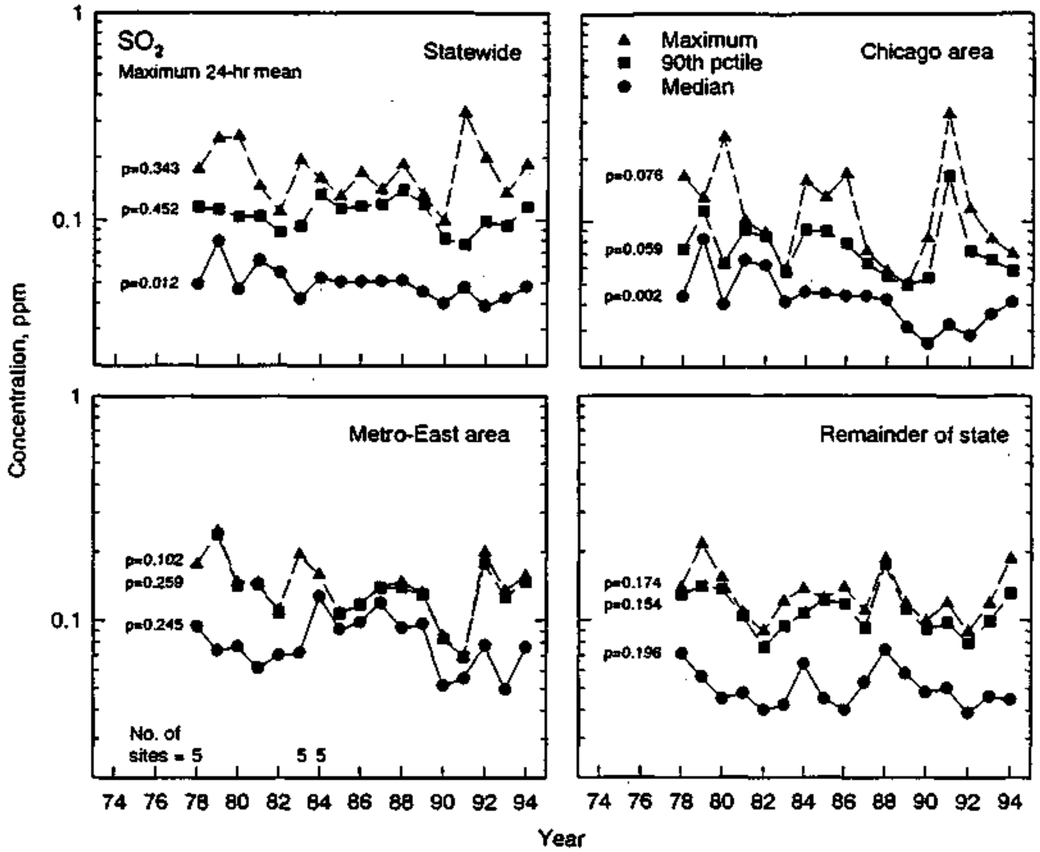

Figure 9. Trends in maximum 24-hr mean SO_2 in Illinois.

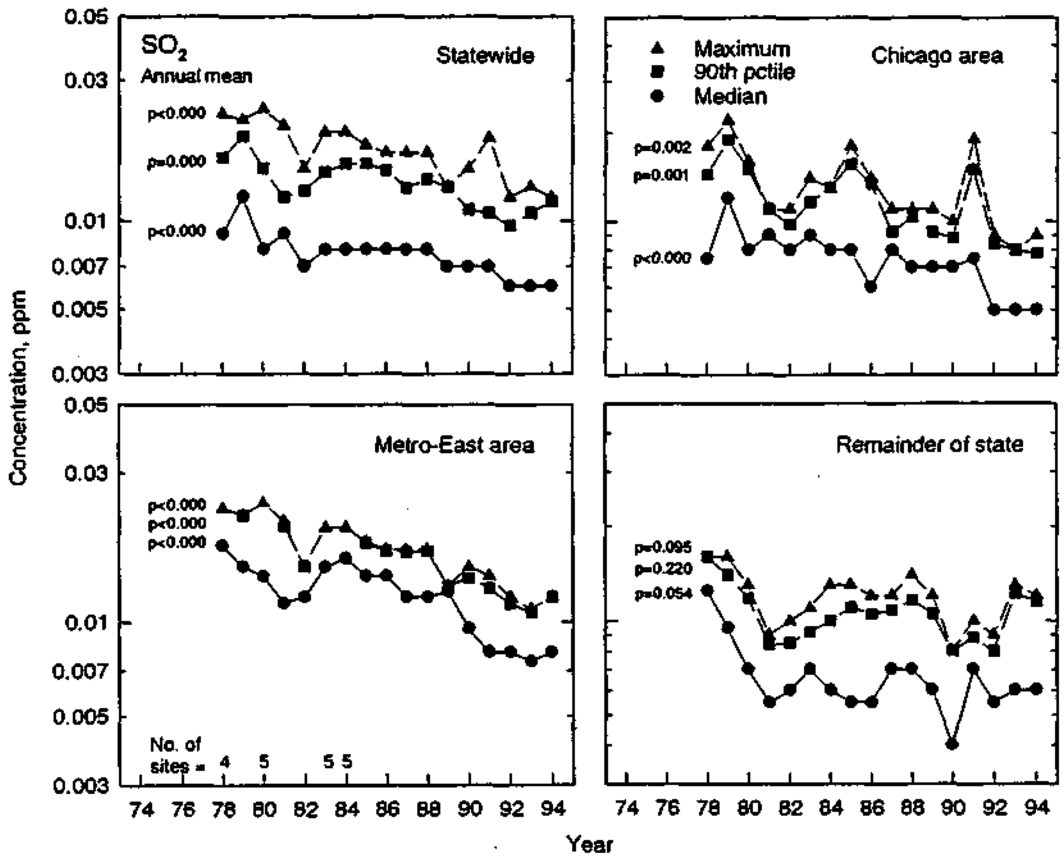

Figure 10. Trends in annual mean SO_2 in Illinois.

Correlations among the maximum 3-hr and 24-hr means in different regions were also low (table 3). The maximum correlation was 0.478, and several correlations were even negative. Correlations between regions were somewhat higher for the annual means, ranging between 0.304 and 0.671, with no clear differences between medians, 90th percentiles, and maximums.

These results show significant trends and inter-regional correlations for annual means, but few significant trends and low correlations for the maximum 3-hr and 24-hr means. This suggests that control efforts have been effective in reducing overall concentrations, perhaps from distant sources, but not the smaller local sources that cause the 3-hr and 24-hr maximum concentrations.

Trends at individual sites are given in table 7. For 3-hr data in the Chicago area, trends at individual sites range from n.s. (two sites) to -14.19% per year, compared to the regional trend of -3.21% per year. Similarly, the Chicago area 24-hr data show trends ranging from n.s. (two sites) to -10.22% per year, compared to the regional trend of -3.77% per year. For the Chicago area annual mean data, all seven sites show significant decreases, ranging from -4.01% to -11.41% per year, compared to the regional value of-3.48% per year. Since the sites where no significant trends were detected had data records ranging from 11-13 years, the overall results could be consistent with what is expected if the cleanest sites were closed first.

In the Metro-East area (table 7), three individual sites show rather strong downward trends in the -5% to -9% per year range, or more, for 3-hr, 24-hr, and annual mean data, while the regional results showed a significant declining trend (-4.36% per year) only for the annual mean. Figures 8 and 9 suggest that in this case a shorter data set for the regional median (i.e., comparable to the 11 and 13 years at the Alton and East St. Louis sites) might well have shown a significant declining trend in maximum 3-hr and 24-hr concentrations. The significant declines at the 17-year Wood River site would appear to be related to local conditions.

Trends were computed for eight individual sites in the Remainder area. For each averaging time, at least three of the sites had no significant trend, in agreement with the regional results. The other individual sites showed one *upward trend* of 5.05% per year for the maximum 24-hr mean at Pekin, but all the rest were downward trends of at least -3% per year. The differences in trend direction and magnitude from site to site and between individual sites and the regional median appear to be related to local conditions, rather than differences in period of record, since some sites with 17-year records had significant trends, and others with shorter records did not.

Total Suspended Particulate Matter (TSP). The current particulate matter standards refer to particles smaller than 10 micrometers in aerodynamic diameter (PM_{10}). Nevertheless, data collected under the old total suspended particulate matter (TSP) are available in Illinois for 1978- 1993. Results for TSP data are shown in tables 2 and 3 and figures 11 and 12. Both statewide and in the Chicago area, only the maximum values had significant trends (figure 2). The trends for both the maximum 24-hr mean and the annual geometric mean in both of these regions were downward. Statewide, the trends were about -5% per year, and they were significant at the

Table 7. Sulfur Dioxide Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Maximum 3-hr mean	Maximum 24-hr mean	Annual mean
Chicago	Bedford Park	1540018	11	1984	1994	-14.19%	n.s.	**-6.13%**
	Edgewater	1220037	13	1982	1994	n.s.	-2.90%	-4.01%
	Northwestern U.	1220039	17	1978	1994	**-5.36%**	**-4.72%**	**-7.02%**
	Chicago-S.E. Police	1220050	14	1981	1994	**-7.91%**	**-10.22%**	**-9.25%**
	Cicero	1340002	12	1983	1994	**-4.16%**	-3.39%	-11.41%
	Lemont	4220001	12	1983	1994	n.s.	n.s.	**-6.39%**
	Lisle	4320001	11	1984	1994	-2.44%	**-5.25%**	**-5.73%**
	Regional medians		17	1978	1994	**-3.21%**	**-3.77%**	**-3.48%**
Metro-East	Alton	160008	11	1984	1994	**-9.01%**	**-11.52%**	**-9.70%**
	Wood River	8520007	17	1978	1994	**-6.27%**	**-8.56%**	**-6.72%**
	E. St. Louis	2120010	13	1979	1994	**-5.63%**	**-5.98%**	**-4.99%**
	Regional medians		17	1978	1994	n.s.	n.s.	**-4.36%**
Remainder	Quincy	6440006	14	1981	1994	**-4.71%**	**-5.82%**	-4.58%
	Decatur	1740013	12	1983	1994	**-10.99%**	**-11.29%**	**-7.69%**
	Nilwood	4640002	13	1982	1994	n.s.	n.s.	**-4.26%**
	Springfield	7280006	17	1978	1994	**-3.56%**	**-5.34%**	N/A
	Peoria	6080024	17	1978	1994	n.s.	n.s.	n.s.
	Pekin	6060004	15	1980	1994	n.s.	5.05%	n.s.
	Champaign	1140004	13	1982	1994	n.s.	n.s.	n.s.
	Moline	5120003	17	1978	1994	-3.28%	**-6.57%**	**-7.74%**
	Regional medians		17	1978	1994	n.s.	n.s.	n.s.

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

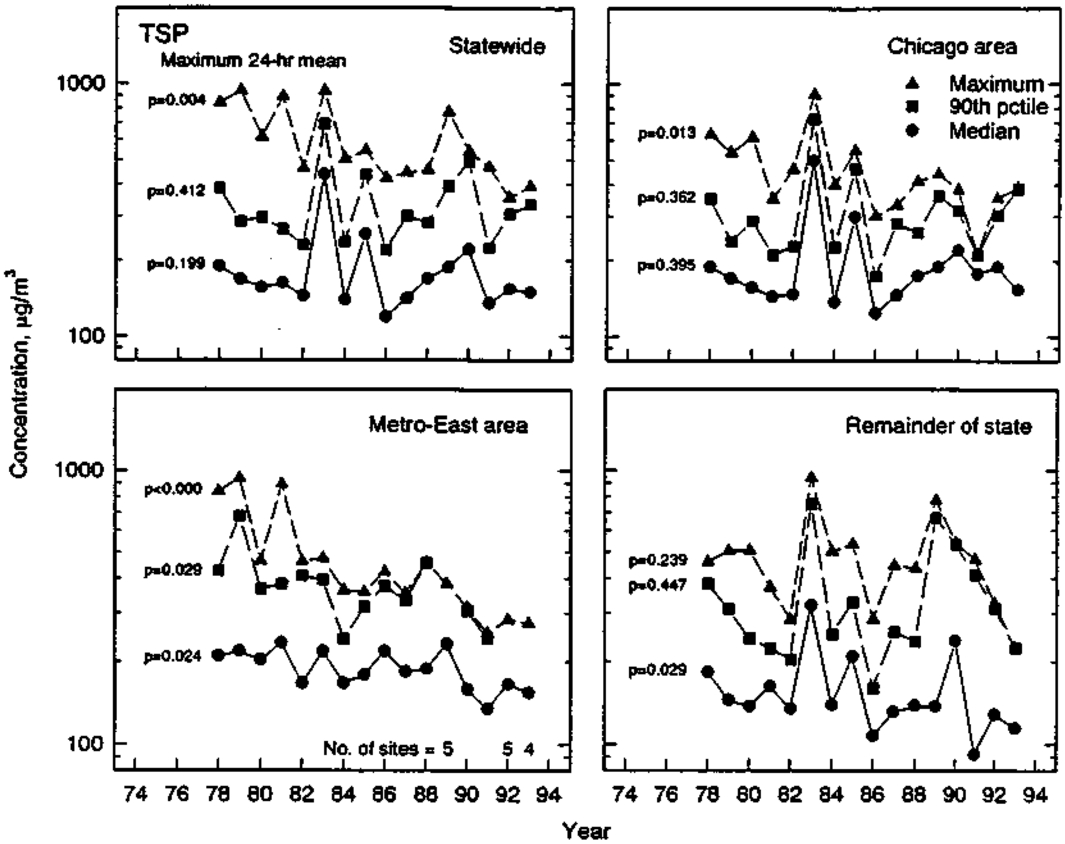

Figure 11. Trends in maximum 24-hr mean total suspended particulate matter in Illinois.

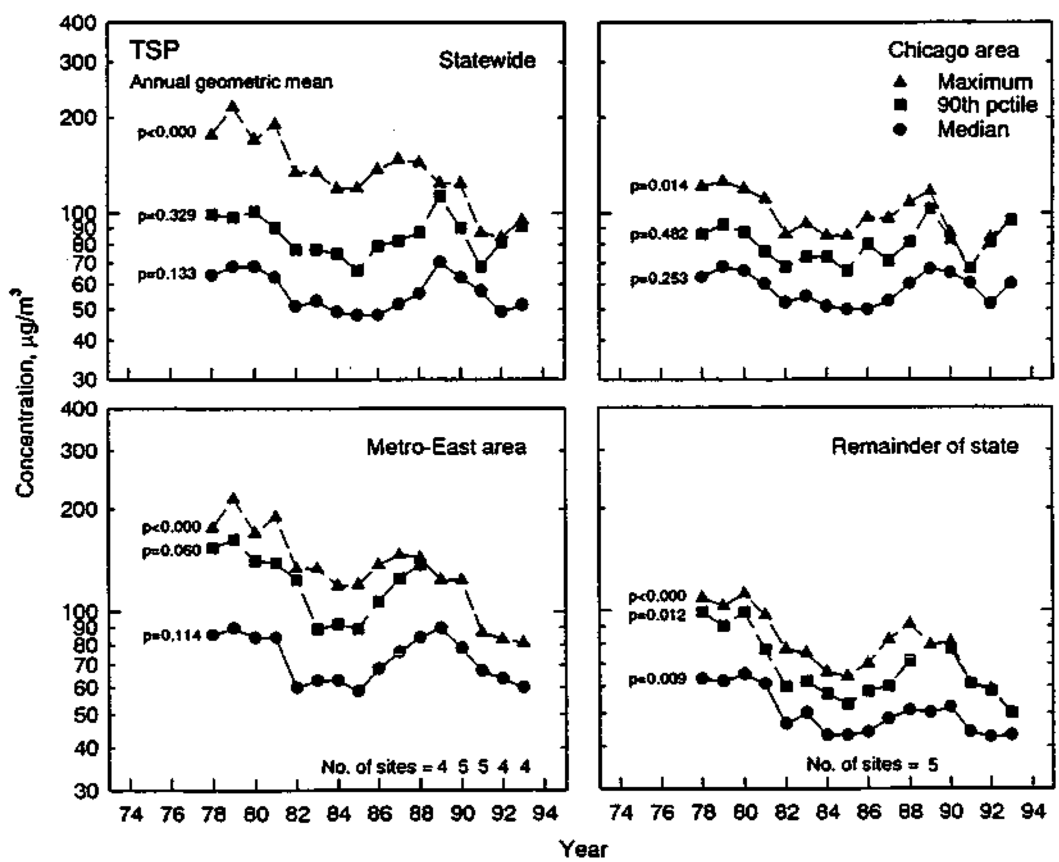

Figure 12. Trends in annual geometric mean total suspended particulate matter in Illinois.

1% level. In the Chicago area the trends were about -2% to -4% per year, and they were significant at the 5% level. In the Metro-East area trends for both the maximum 24-hr mean and the annual geometric mean were also downward (-5% to -8% per year), with significance at the 1% level. The median and 90th percentile values of the maximum 24-hr mean also showed downward trends in the Metro-East area, with significance at the 5% level. In the Remainder of the state all three concentration levels of the annual geometric mean had downward trends (-0.75% to -3.99% per year) significant at the 1% level.

Correlations between regional TSP concentrations are shown in table 3. For the maximum 24-hr mean, the correlations between Chicago and the Remainder of the state were the only ones higher than 0.32. The Chicago and Remainder correlations ranged from 0.641 to 0.876, and were highest for median concentrations. For annual mean TSP, correlations between regions were all >0.700 for all three concentration levels, with one exception.

For TSP the significant declines in both 24-hr and annual geometric mean concentrations occurred at the maximum concentrations in the large urban areas. Only Chicago and the Remainder category had high correlations of maximum 24-hr concentrations, but all regions had high correlations with each other for all concentration levels of the annual geometric mean. Current controls seem to be effective in reducing the highest concentrations over both 24-hr and annual averaging periods, although it is clear from the highly variable traces in figure 11 that maximum 24-hr TSP concentrations are strongly influenced by random dry and windy weather conditions. The annual geometric means are highly correlated between regions, for both declining and non-declining concentrations. Thus, they appear to be controlled by large-scale phenomena, which could include both uniform federal control measures as well as large-scale weather features.

Trend results for individual sites are given in table 8. In the Chicago area, the regional result of no significant trends in either 24-hr or annual mean is in good agreement overall with results for five individual sites, although two sites showed significant declines in the maximum 24-hr mean. In the Metro-East area, the regional decline of -2.01% per year is reasonable compared to three individual site trends ranging from n.s to -6.45% per year.

The Metro-East annual geometric mean shows a discrepancy between the regional and individual site results, however. The regional trend was n.s., but the three individual sites all show declines close to -4% per year, and are all significant at the 1% level. The periods of record are all about the same for the individual sites and the regional medians, so that cannot be a cause for the different results. These differences are in the direction expected if the cleanest sites were closed first.

In the Remainder region, the five individual sites show trends ranging from n.s. to declines of up to -8.15% per year for the 24-hr data and up to -4.80% per year for the annual geometric mean. The regional trends were both downward at about -2% per year, in general agreement with the individual site trends.

Table 8. TSP Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Maximum 24-hr mean	Annual geo mean
Chicago	Alsip	140001	14	1980	1993	n.s.	**-1.99%**
	Chicago--Cermak	1220026	12	1982	1993	n.s.	N/A
	Chicago--Mayfair	1220052	12	1982	1993	n.s.	n.s.
	Chicago--Washington	1220022	16	1978	1993	**-5.67%**	N/A
	Joliet	3760002	16	1978	1993	-3.59%	n.s.
	Regional medians		16	1978	1993	n.s.	n.s.
Metro-East	E. St. Louis	2120010	15	1979	1993	**-6.45%**	**-4.73%**
	Granite City	2960007	16	1978	1993	**-2.20%**	**-3.79%**
	Granite City	2960010	16	1978	1993	n.s.	**-4.17%**
	Regional medians		16	1978	1993	-2.01%	n.s.
Remainder	Oglesby	5800007	11	1983	1993	n.s.	n.s.
	Rockford	6680011	14	1980	1993	n.s.	N/A
	Decatur	1740002	16	1978	1993	**-3.72%**	**-4.80%**
	Nilwood	4640002	12	1982	1993	**-8.15%**	**-2.82%**
	E. Moline	2080001	16	1978	1993	n.s.	n.s.
	Regional medians		16	1978	1993	-2.00%	**-2.49%**

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

PM_{10}. Trend results for maximum 24-hr mean and annual mean PM_{10} concentrations are given in table 2 and in figures 13 and 14, respectively. The maximum 24-hr mean concentration had significant downward trends in the Remainder region for median, 90th percentile, and maximum values. Also, 90th percentile values had significant downward trends statewide for both averaging times. Similarly, median concentrations had significant downward trends in the Metro-East area. All but two of the annual mean trends were significant at the 5% level, with values ranging from about -2% to -10% per year. Only five of 12 trends were significant for the maximum 24-hr mean, with values ranging from about -5.1% to -11.5% per year.

Inter-regional correlations of maximum 24-hr means were mostly less than 0.40. The exceptions were a coefficient of 0.581 between Chicago and Metro-East for 90th percentile values, and another of 0.667 between Metro-East and Remainder medians. The annual means produced some higher correlations between regions. All three concentration levels show coefficients >0.85 between Metro-East and the Remainder area.

Trends at individual sites are given in table 9. In all three regions the individual site trends are in general agreement with those of the regional medians.

Nitrate (NO_3^-). Trends in annual mean airborne nitrate concentrations were downward (table 2 and figure 15) both statewide and in both large metropolitan areas for each concentration level with enough data for a trend test, except for one where the trend was not significant. All the significant trends were between -0.83% and -1.89% per year, with the larger rates of decline occurring in the higher (90th percentile and maximum) concentrations. No significant nitrate trends were found in the Remainder region. Figure 15 shows a short-term upward trend for all concentration levels in all regions after 1991, but this trend is too short to determine its significance at this time.

The correlation analysis (table 3) shows correlations >0.600 between the three regions for the maximum concentrations, but for median concentrations only the Metro-East and Remainder regions are highly correlated. This pattern is similar to that of TSP.

Table 10 presents trend results for individual sites. No significant trends were detected at any of the individual sites. This agrees with results for the regional medians in the Chicago and Remainder areas, but a downward trend of about -1% in the regional median was found for the Metro-East area. Figure 15 suggests that the differences in period of record could explain why there is a significant trend in the regional median (17 years), but not at any of the three individual Metro-East sites (the most recent 12-15 years).

Sulfate (SO_4^{2-}). Annual mean concentrations of airborne sulfate showed significant decreasing trends (table 2 and figure 16) in all regions and for all concentration levels with enough data to test (ten of the possible twelve). Eight of the ten were significant at the 1% level, the other two at the 5% level. In all four regions, the maximum concentrations had the highest rates of decline, approximately -2% per year. As in the case of nitrate, medians, 90th percentile values,

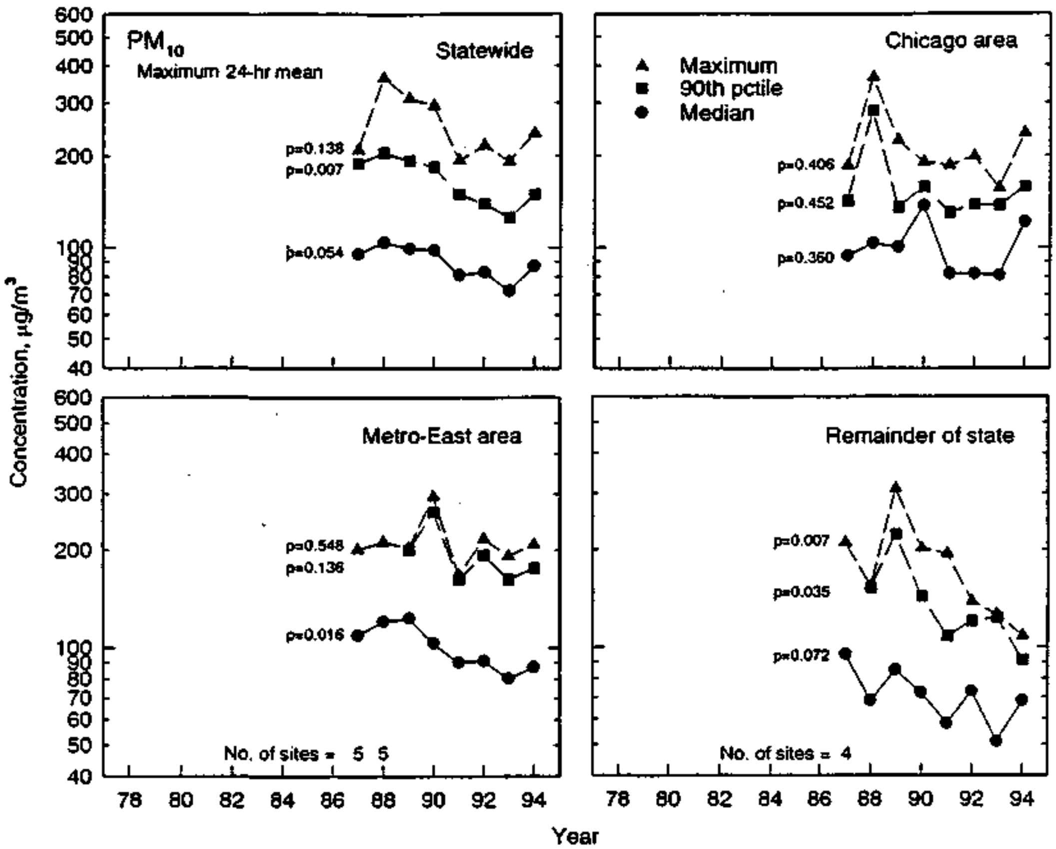

Figure 13. Trends in maximum 24-hr PM_{10} in Illinois.

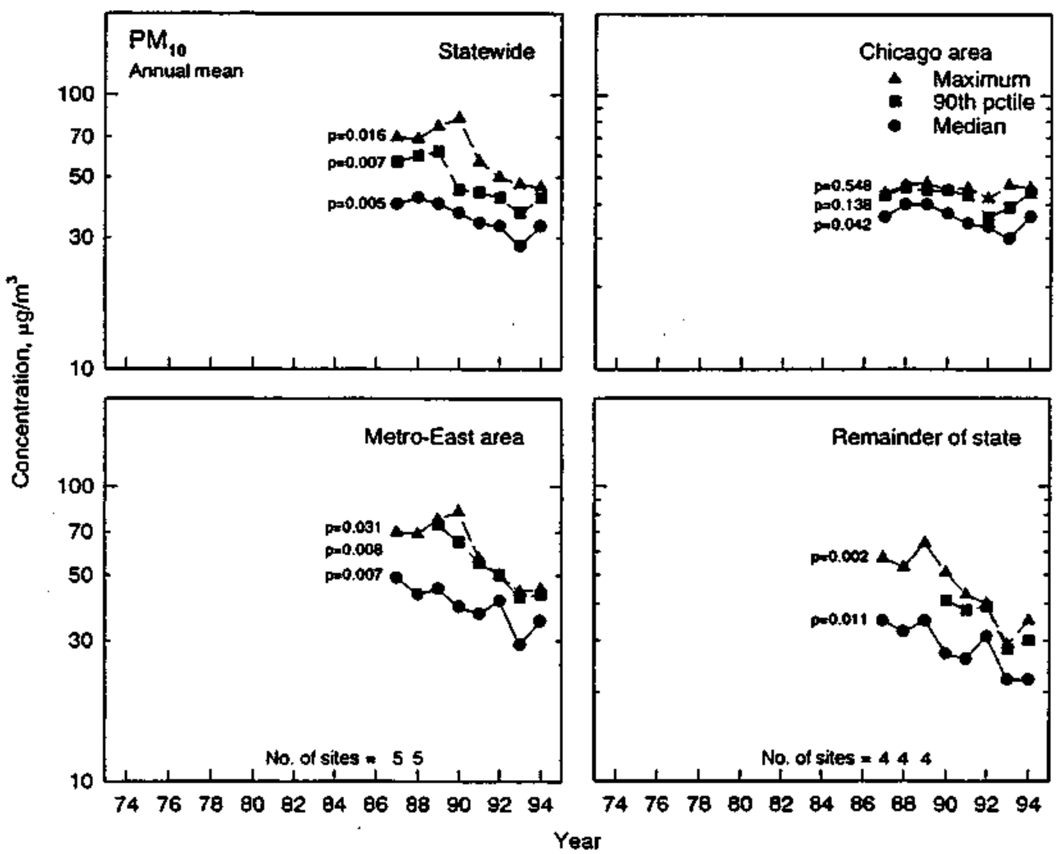

Figure 14. Trends in annual mean PM_{10} in Illinois.

Table 9. PM-10 Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Annual Mean
Chicago	Blue Island	500001	8	1987	1994	n.s.
	Chicago--Farr	1220014	8	1987	1994	n.s.
	Chicago--Washington	1220022	8	1987	1994	-3.19%
	Cicero	1340001	7	1988	1994	n.s.
	Joliet	3760002	8	1987	1994	**-4.46%**
	Regional medians		8	1987	1994	-2.04%
Metro-East	E. St. Louis	2120010	8	1987	1994	-4.90%
	Granite City	2960007	8	1987	1994	**-3.88%**
	Granite City	2960010	8	1987	1994	n.s.
	Wood River	8520007	8	1987	1994	-4.04%
	Regional medians		8	1987	1994	**-5.53%**
Remainder	Peoria	6080037	8	1987	1994	-4.09%
	E. Moline	2080001	6	1989	1994	-6.86%
	Oglesby	5800007	8	1987	1994	**-8.65%**
	Decatur	1740002	8	1987	1994	-4.71%
	Regional medians		8	1987	1994	-6.28%

Notes:

* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

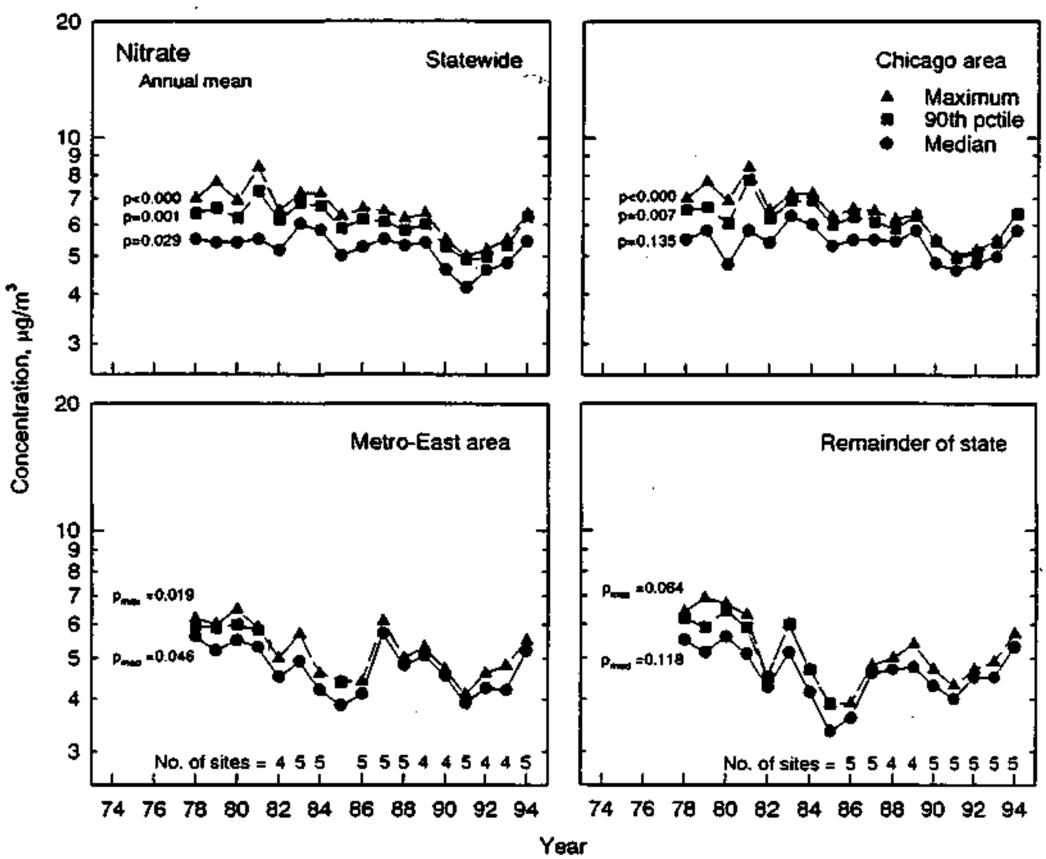

Figure 15. Trends in annual mean nitrate in Illinois.

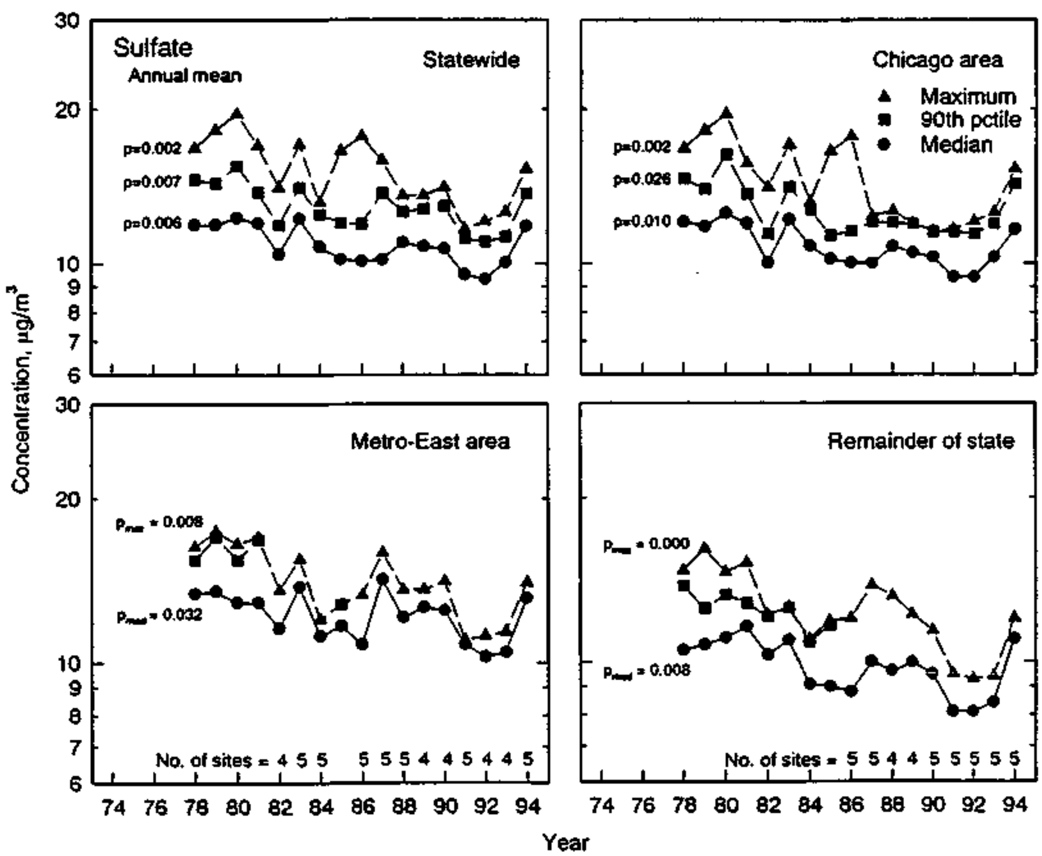

Figure 16. Trends in annual mean sulfate in Illinois.

Table 10. Nitrate Trend Results for Individual Sampling Sites and Regional Means.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Annual Mean
Chicago	Alsip	140001	6	1989	1994	n.s.
	Chicago--Cermak	1220026	12	1983	1994	n.s.
	Chicago--Mayfair	1220052	12	1983	1994	n.s.
	Joliet	3760002	12	1983	1994	n.s.
	Maywood	4960003	8	1987	1994	n.s.
	Schiller Park	7040001	9	1986	1994	n.s.
	Regional medians		17	1978	1994	n.s.
Metro-East	E. St. Louis	2120010	15	1980	1994	n.s.
	Granite City	2960007	12	1983	1994	n.s.
	Granite City	2960010	12	1983	1994	n.s.
	Regional medians		17	1978	1994	-1.06%
Remainder	Decatur	1740002	12	1983	1994	n.s.
	Nilwood	4640002	13	1982	1994	n.s.
	Peoria	6080037	8	1987	1994	n.s.
	E. Moline	2080001	17	1978	1994	n.s.
	Regional medians		17	1978	1994	n.s.

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

and maximums have been increasing in all regions since reaching low points in 1991 or 1992 (figure 16).

The correlation analysis (table 3) shows correlations >0.600 between the three regions for both maximum and median concentrations. These high correlations are consistent with a scenario involving regional coal-fired power plant emissions and transport under the influence of large-scale weather systems.

Trends at individual sites are shown in table 11. In each region, all but one of the individual sites had no significant trend. The one significant trend found in the Chicago area was 1.5% per year *upward,* as opposed to an approximately *-1%* per year downward trend in the regional median. This upward trend is based on the last 12 years of record and would not be considered unusual in view of the trend in regional median values (figure 16) over that period. These differences are the opposite of those expected from bias due to preferential closing of cleaner sites. In the Metro-East and Remainder areas the sites with 17-year data records had significant downward trends of about -2% per year, substantially in agreement with the regional medians, which were also downward at about -1% per year. The individual sites where no trends were detected all had shorter data records.

Arsenic (As). Like nitrate and sulfate, annual mean arsenic concentrations at all levels have been declining in all areas of the state (table 2 and figure 17). Seven of the ten computable trends were significant at the 1% level and the other three at the 5% level. Statewide and in the large urban areas the maximum concentrations declined the most, with rates between -12% and -21% per year (table 2). The medians declined between -4% and -10% per year.

Only two correlations (table 3) exceeded 0.600. Maximums in the Chicago and Metro-East areas had a correlation coefficient of 0.623, which may reflect widespread efforts to reduce industrial emissions. Medians in the Chicago and Remainder regions had a correlation coefficient of 0.806.

Table 12 gives trend results for individual sites. None of the five individual sites in the Chicago area had a significant trend, although the trend in the regional median was about -7% per year. The explanation for the difference probably lies in the fact that the periods of record for the individual sites were all the most recent 6, 9, or 12 years, while that of the regional median was 17 years. As shown in figure 17, most of the decline in median arsenic annual mean concentrations in the Chicago area occurred before 1984. In the Metro-East area, the three individual sites had declines of -8% to -13% per year, somewhat greater than the decline in the regional median of about -5% per year. These differences are consistent with those expected from preferentially closing cleaner sites.

In the Remainder area, three of the four individual sites had no significant trend, while the trend in the regional median was about -9% per year. The one site that did have a trend (about -10% per year) had a data record of 17 years, the same as the regional medians.

Table 11. Sulfate Trend Results for Individual Sampling Sites and Regional Means.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Annual Mean
Chicago	Alsip	140001	6	1989	1994	n.s.
	Chicago--Cermak	1220026	12	1983	1994	**1.50%**
	Chicago--Mayfair	1220052	12	1983	1994	n.s.
	Joliet	3760002	12	1983	1994	n.s.
	Maywood	4960003	8	1987	1994	n.s.
	Schiller Park	7040001	9	1986	1994	n.s.
	Regional medians		17	1978	1994	**-1.03%**
Metro-East	E. St. Louis	2120010	15	1980	1994	n.s.
	Granite City	2960007	12	1983	1994	n.s.
	Granite City	2960010	17	1978	1994	**-2.11%**
	Regional medians		17	1978	1994	-0.87%
Remainder	Decatur	1740002	12	1983	1994	n.s.
	Nilwood	4640002	13	1982	1994	n.s.
	Peoria	6080037	8	1987	1994	n.s.
	E. Moline	2080001	17	1978	1994	-1.65%
	Regional medians		17	1978	1994	**-1.10%**

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

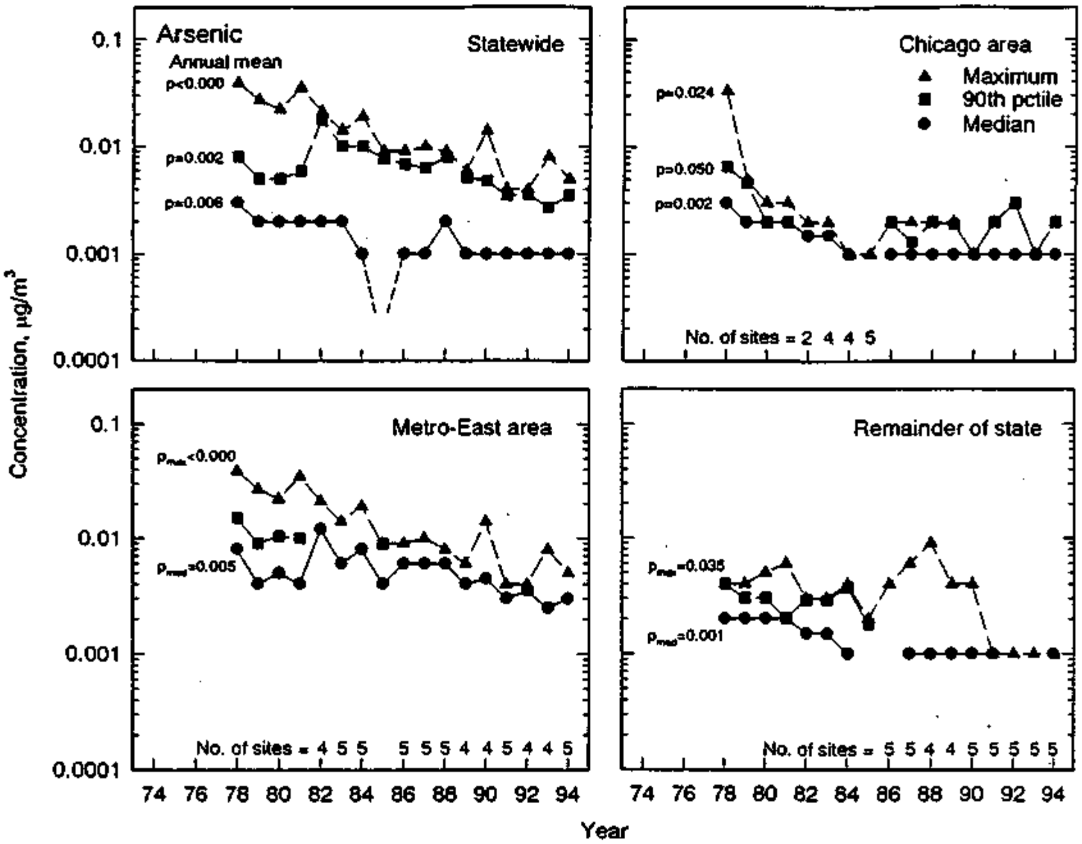

Figure 17. Trends in annual mean arsenic in Illinois.

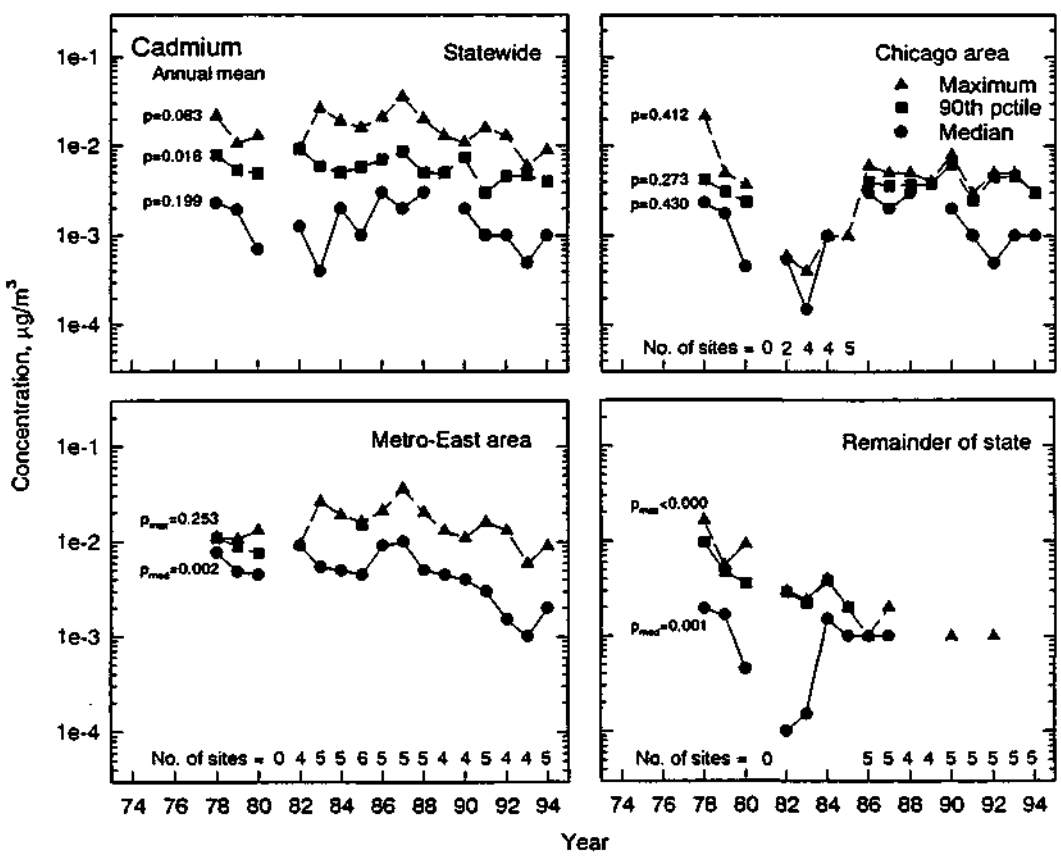

Figure 18. Trends in annual mean cadmium in Illinois.

Table 12. Arsenic Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Annual Mean
Chicago	Chicago--Cermak	1220026	6	1989	1994	n.s.
	Chicago--Mayfair	1220052	6	1989	1994	n.s.
	Joliet	3760002	12	1983	1994	n.s.
	Maywood	4960003	6	1989	1994	n.s.
	Schiller Park	7040001	9	1986	1994	n.s.
	Regional medians		17	1978	1994	**-6.95%**
Metro-East	E. St. Louis	2120010	15	1980	1994	**-8.38%**
	Granite City	2960007	12	1983	1994	-8.55%
	Granite City	2960010	17	1978	1994	**-12.84%**
	Regional medians		17	1978	1994	**-4.75%**
Remainder	Decatur	1740002	12	1983	1994	n.s.
	Nilwood	4640002	13	1982	1994	n.s.
	Peoria	6080037	7	1988	1994	n.s.
	E. Moline	2080001	17	1978	1994	-9.57%
	Regional medians		17	1978	1994	**-9.44%**

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

Cadmium (Cd). Trend results for annual mean cadmium concentrations were highly variable; they appear in table 2 and figure 18. Six of the ten computable trends were not significant. All of the significant trends were downward, and three of the four were significant at the 1% percent level. Median and maximum values in the Remainder region had large downward trends of -19.43% and -26.54% per year, respectively. The other significant downward trends were for median concentrations in the Metro-East area and 90th percentile concentrations statewide.

Only one correlation (table 3) exceeded 0.600. Maximum concentrations in the Chicago and Remainder areas had a correlation coefficient of 0.692.

Trend results for individual sites are shown in table 13. Four of the six sites in the Chicago area had no significant trends, in agreement with that of the regional median. The two sites that showed significant downward trends had data records of the most recent eight and nine years, for which the regional median (figure 18) also shows decreasing concentrations. In the Metro-East area, all three individual sites showed downward trends of about -5% to -13% per year, compared to a downward trend of -7% per year in the regional median. Figure 18 suggests that the difference in data period may account for these differences, because the decline in the regional median occurred after 1987. In the Remainder area, strong downward trends, in agreement with that of the regional median, were found at all of the individual sites except the one with the shortest (7-year) data record.

Chromium (Cr). Trend results for annual mean chromium concentrations are given in table 2 and figure 19. Note that measurements began in 1985, somewhat later than most of the other pollutants. Statewide, trends were downward at all concentration levels, at rates ranging from -8.57% per year (90th percentile) to -19.65% per year (median). Each of the subregions had one concentration level with a significant downward trend: Chicago area (90th percentile), Metro-East area (maximum), and Remainder area (median). (Figure 19 shows that, aside from the unusually low median and maximum in 1984, these concentrations levels have also declined.) The rates of decline in table 2 range from about -12% to about -22% per year. Thus, for chromium, where the rates of decline are significant, the percentages are quite large.

Chromium concentrations are quite well correlated between regions (table 3). For medians, the three correlation coefficients all exceed 0.600. For maximums, the values are slightly lower, but still indicate good correlation between regions.

Trends at individual sites are shown in table 14. In the Chicago area, three of the six individual sites had no significant trend, in agreement with that of the regional median, but the other three sites had strong downward trends of -25% to -33% per year. Figure 19 shows that the regional median probably would have had a significant downward trend also, except for the anomalously low value during the first year of data. In the Metro-East area, two of the three individual sites had significant downward trends, while the third agrees with that of the regional

Table 13. Cadmium Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Annual Mean
Chicago	Alsip	140001	6	1989	1994	n.s.
	Chicago--Cermak	1220026	9	1986	1994	-14.97%
	Chicago--Mayfair	1220052	9	1986	1994	n.s.
	Joliet	3760002	12	1983	1994	n.s.
	Maywood	4960003	8	1987	1994	n.s.
	Schiller Park	7040001	8	1987	1994	-38.10%
	Regional medians		16	1979	1994	n.s.
Metro-East	E. St. Louis	2120010	13	1982	1994	**-4.95%**
	Granite City	2960007	12	1983	1994	**-10.07%**
	Granite City	2960010	13	1982	1994	**-13.06%**
	Regional medians		16	1979	1994	**-7.15%**
Remainder	Decatur	1740002	12	1983	1994	-23.40%
	Nilwood	4640002	13	1982	1994	-28.26%
	Peoria	6080037	7	1988	1994	n.s.
	E. Moline	2080001	13	1982	1994	-17.65%
	Regional medians		16	1979	1994	**-19.43%**

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

Table 14. Chromium Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Annual Mean
Chicago	Alsip	140001	6	1989	1994	n.s.
	Chicago--Cermak	1220026	9	1986	1994	-32.84%
	Chicago--Mayfair	1220052	9	1986	1994	n.s.
	Maywood	4960003	8	1987	1994	n.s.
	Schiller Park	7040001	9	1986	1994	-26.95%
	Joliet	3760002	10	1985	1994	-24.55%
	Regional medians		10	1985	1994	n.s.
Metro-East	E. St. Louis	2120010	10	1985	1994	-18.95%
	Granite City	2960007	10	1985	1994	n.s.
	Granite City	2960010	10	1985	1994	-9.43%
	Regional medians		10	1985	1994	n.s.
Remainder	Decatur	1740002	10	1985	1994	-20.00%
	Nilwood	4640002	10	1985	1994	n.s.
	Peoria	6080037	7	1988	1994	n.s.
	E. Moline	2080001	7	1988	1994	n.s.
	Regional medians		10	1985	1994	-22.35%

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

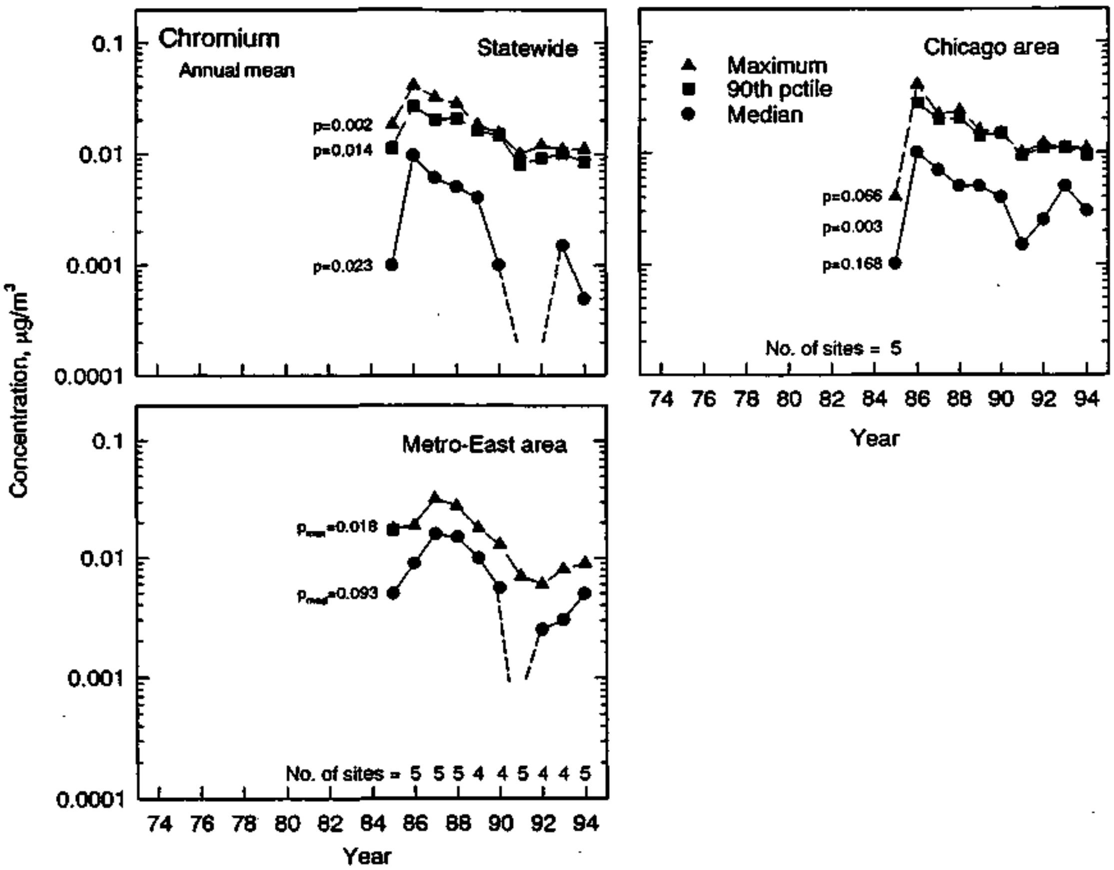

Figure 19. Trends in annual mean chromium in Illinois. Data for the "Remainder" area were inadequate to plot.

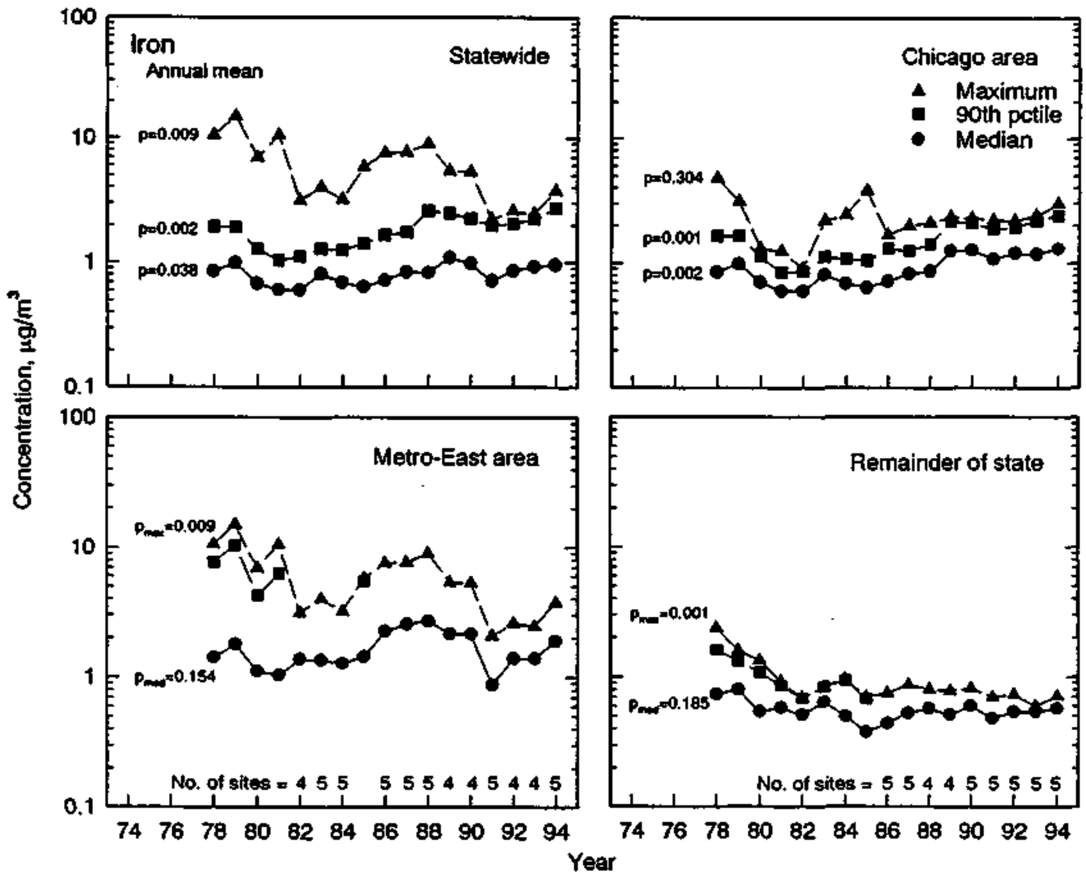

Figure 20. Trends in annual mean iron in Illinois.

median, with no significant trend. The individual sites all have ten years of record, the same as the regional median, so differences in period of record are not a factor.

In the Remainder area, three of the four individual sites had no significant trend, but the fourth had a strong downward trend (-20% per year) that agrees with that of the regional median. In all regions, differences in trend between sites and between individual sites and regional trends would appear to be related to local conditions.

Iron (Fe). Annual mean concentrations of airborne iron show significant trends both upward and downward in Illinois (table 2 and figure 20). Statewide, medians and 90th percentile values increased at an average 1.29% and 3.56% per year, respectively, while maximum values declined at -7.68% per year. Increasing medians (3.68% per year) and 90th percentile values (4.26% per year) were also seen in the Chicago area. Figure 20 also shows that the maximum value has also been rising consistently since 1986, even though its overall trend is not significant. The only significant trends in the Metro-East and Remainder areas are downward trends of -7.72% and -7.13% per year, respectively, for maximum values. All these rates are significant at the 1% level except the statewide median rate, which is significant at the 5% level.

Correlations of iron concentrations between regions (table 3) were mostly low, but maximum concentrations in the Remainder region had correlations of 0.564 with those in the Chicago area and 0.645 with those in the Metro-East area.

Table 15 shows trend results for individual sites. In the Chicago area four of seven sites had no significant trend, while three had upward trends in the 4% to 6% per year range. The regional median also had a significant upward trend of about 4% per year. The individual sites had a maximum of 12 years of data, as compared to 17 years for the regional median, but there is no indication that the occurrence of a significant trend is related to the length of the data period. The varying results are probably caused by varying local conditions.

In the Metro-East and Remainder areas, most individual sites show significant downward trends, whereas both regional medians showed no significant trends. The reason for these differences would not appear to be differences in period of record, since in each region one site with a significant downward trend had a data record as long as that of the regional median. Again, local conditions appear to be the explanation. The differences are in the direction of a possible bias effect.

Manganese (Mn). Trend results for annual mean manganese concentrations (table 2 and figure 21) are quite similar to those for iron. Statewide, although the trend for median concentrations is not significant, that for the 90th percentile was up (4.44% per year) and that for the maximum was down (-8.84% per year). Like those of iron, manganese trends in the Chicago area were up for both medians (1.65% per year) and the 90th percentile (7.34% per year). Also like iron, all the significant trends in the Metro-East and Remainder areas were downward, -9.49% per year and -10.41% per year, respectively, for the maximums. All these trends are

Table 15. Iron Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Annual Mean
Chicago	Alsip	140001	6	1989	1994	n.s.
	Chicago--Cermak	1220026	12	1983	1994	**6.14%**
	Chicago--Mayfair	1220052	12	1983	1994	**5.48%**
	Chicago--Washington	1220022	12	1983	1994	n.s.
	Joliet	3760002	12	1983	1994	n.s.
	Maywood	4960003	8	1987	1994	4.34%
	Schiller Park	7040001	9	1986	1994	n.s.
	Regional medians		17	1978	1994	**3.68%**
Metro-East	E. St. Louis	2120010	15	1980	1994	**-3.58%**
	Granite City	2960007	12	1983	1994	-4.04%
	Granite City	2960010	17	1978	1994	**-4.46%**
	Regional medians		17	1978	1994	n.s.
Remainder	Decatur	1740002	12	1983	1994	-2.54%
	Nilwood	4640002	13	1982	1994	-3.30%
	Peoria	6080037	7	1988	1994	n.s.
	E. Moline	2080001	17	1978	1994	**-4.63%**
	Regional medians		17	1978	1994	n.s.

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

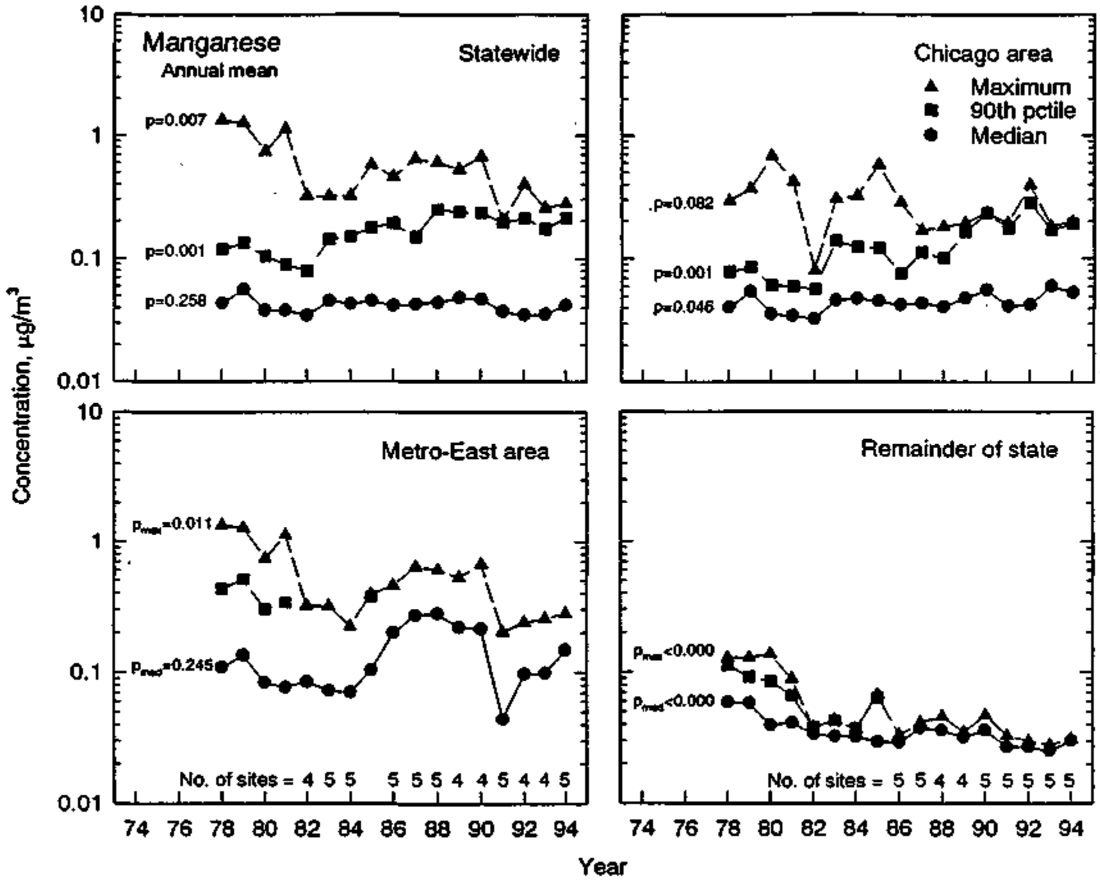

Figure 21. Trends in annual mean manganese in Illinois.

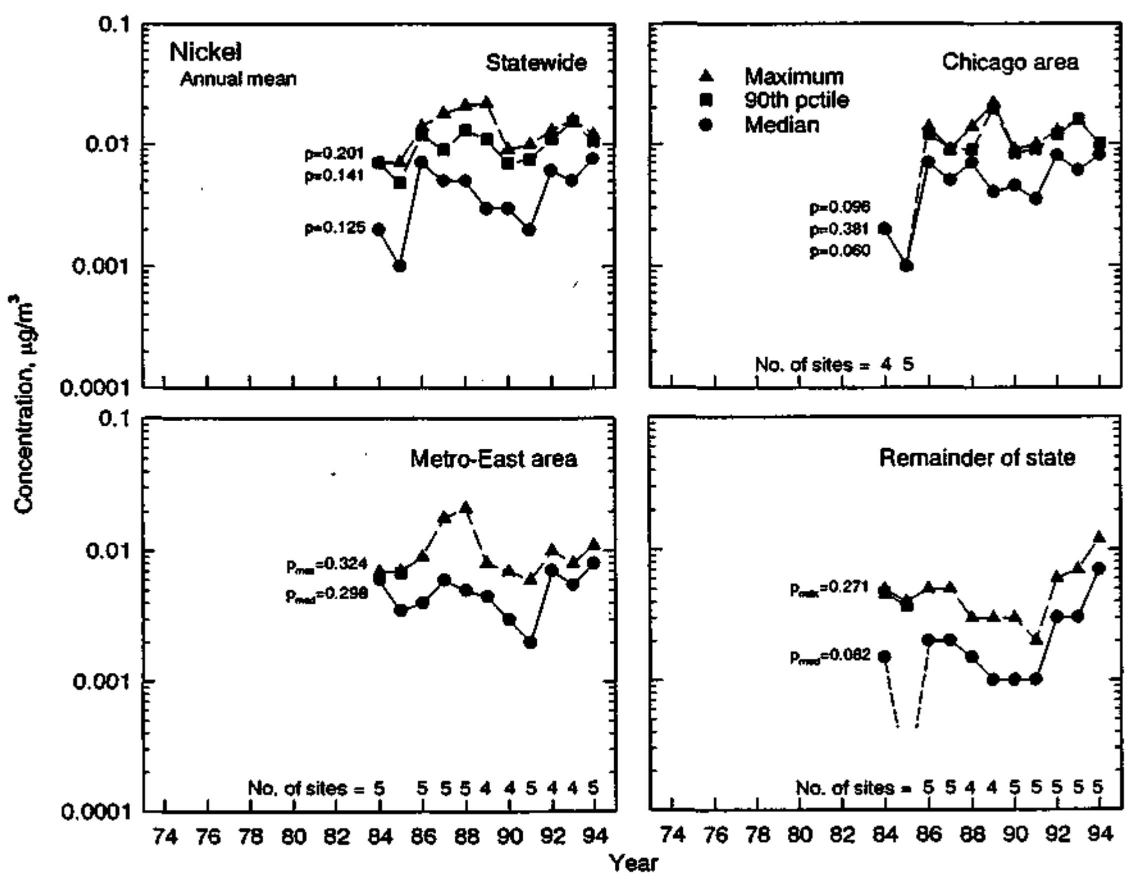

Figure 22. Trends in annual mean nickel in Illinois.

significant at the 1% level except for the Chicago median and the Metro-East maximum, which are significant at the 5% level.

The correlation pattern for manganese is also similar to that of iron. Most correlations were low, except that maximum concentrations in the Remainder region had correlations of 0.619 with those in the Chicago area and 0.832 with those in the Metro-East area.

Trend results for individual sites are shown in table 16. Significant trends at the seven sites in the Chicago area ranged from a 2.11% per year upward trend to a -10.13% per year downward trend, with three sites having no significant trend. The trend in the regional median was -1.65% per year, which is within the range of the trends at the individual sites. In the Metro-East area, two of the three individual sites had significant downward trends; the other had no significant trend, in agreement with the regional median. Figure 21 shows a rather constant regional median concentration during the first seven years of data, followed by increased variability after 1984, so differences in the length of the data periods are not likely to be the cause of the difference in trends between the sites and the regional median. Varying local conditions are the most likely cause. In the Remainder region, similar downward trends were found for all four individual sites and the regional median.

Nickel (Ni). Trend results for annual mean nickel concentrations are shown in table 2 and figure 22. No significant trends were found (table 2). Figure 22 shows that the data set for nickel is shorter than most; the first measurements by IEPA were in 1984.

Inter-regional correlations of the maximum values were very low, but median values showed correlation coefficients ranging from 0.538 to 0.773.

Individual site trends are shown in table 17. With two exceptions, individual sites in all regions showed no significant trends, the same result found for all three regional medians.

Trajectories

One of the lesser objectives of this work was to obtain and test the Hybrid Single-Particle Lagrangian Integrated Trajectory (HY-SPLIT) trajectory software from the National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory (ARL), so it would be available for future research. The software was obtained from ARL, and upper air wind data for 1993, 1994, and 1995, needed as input to the trajectory model, were obtained from the National Climatic Data Center. Figure 23 shows some examples of the back-trajectories computed and plotted by the HY-SPLIT model. The trajectories shown are four-day back-trajectories at the 950 mb level for all dates in 1994 on which ozone exceeded the standard of 0.12 ppm for the maximum 1-hr average at one or more sites in Illinois.

Table 16. Manganese Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Annual Mean
Chicago	Alsip	140001	6	1989	1994	n.s.
	Chicago--Cermak	1220026	12	1983	1994	**2.11%**
	Chicago--Mayfair	1220052	12	1983	1994	**-10.13%**
	Chicago--Washington	1220022	12	1983	1994	-7.81%
	Joliet	3760002	12	1983	1994	**-3.66%**
	Maywood	4960003	8	1987	1994	n.s.
	Schiller Park	7040001	9	1986	1994	n.s.
	Regional medians		17	1978	1994	-1.65%
Metro-East	E. St. Louis	2120010	15	1980	1994	**-6.61%**
	Granite City	2960007	12	1983	1994	n.s.
	Granite City	2960010	12	1983	1994	**-4.75%**
	Regional medians		17	1978	1994	n.s.
Remainder	Decatur	1740002	12	1983	1994	-1.71%
	Nilwood	4640002	13	1982	1994	-2.63%
	Peoria	6080037	8	1987	1994	-7.72%
	E. Moline	2080001	17	1978	1994	**-6.15%**
	Regional medians		17	1978	1994	**-4.33%**

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

Table 17. Nickel Trend Results for Individual Sampling Sites and Regional Medians.

Region	Site name	SAROAD code	Consecutive years	First year	Last year	Trend, as percent of overall mean * Annual Mean
Chicago	Alsip	140001	6	1989	1994	n.s.
	Chicago--Cermak	1220026	9	1986	1994	n.s.
	Chicago--Mayfair	1220052	9	1986	1994	10.03%
	Joliet	3760002	11	1984	1994	n.s.
	Maywood	4960003	8	1987	1994	n.s.
	Schiller Park	7040001	9	1986	1994	n.s.
	Regional medians		11	1984	1994	n.s.
Metro-East	E. St. Louis	2120010	11	1984	1994	n.s.
	Granite City	2960007	11	1984	1994	n.s.
	Granite City	2960010	11	1984	1994	n.s.
	Regional medians		11	1984	1994	n.s.
Remainder	Decatur	1740002	11	1984	1994	n.s.
	Nilwood	4640002	11	1984	1994	33.01%
	Peoria	6080037	7	1988	1994	n.s.
	E. Moline	2080001	11	1984	1994	n.s.
	Regional medians		11	1984	1994	n.s.

Notes:
* Percent trend in bold = significant at 1% level; others significant at 5% level. n.s. = not significant (5% level).

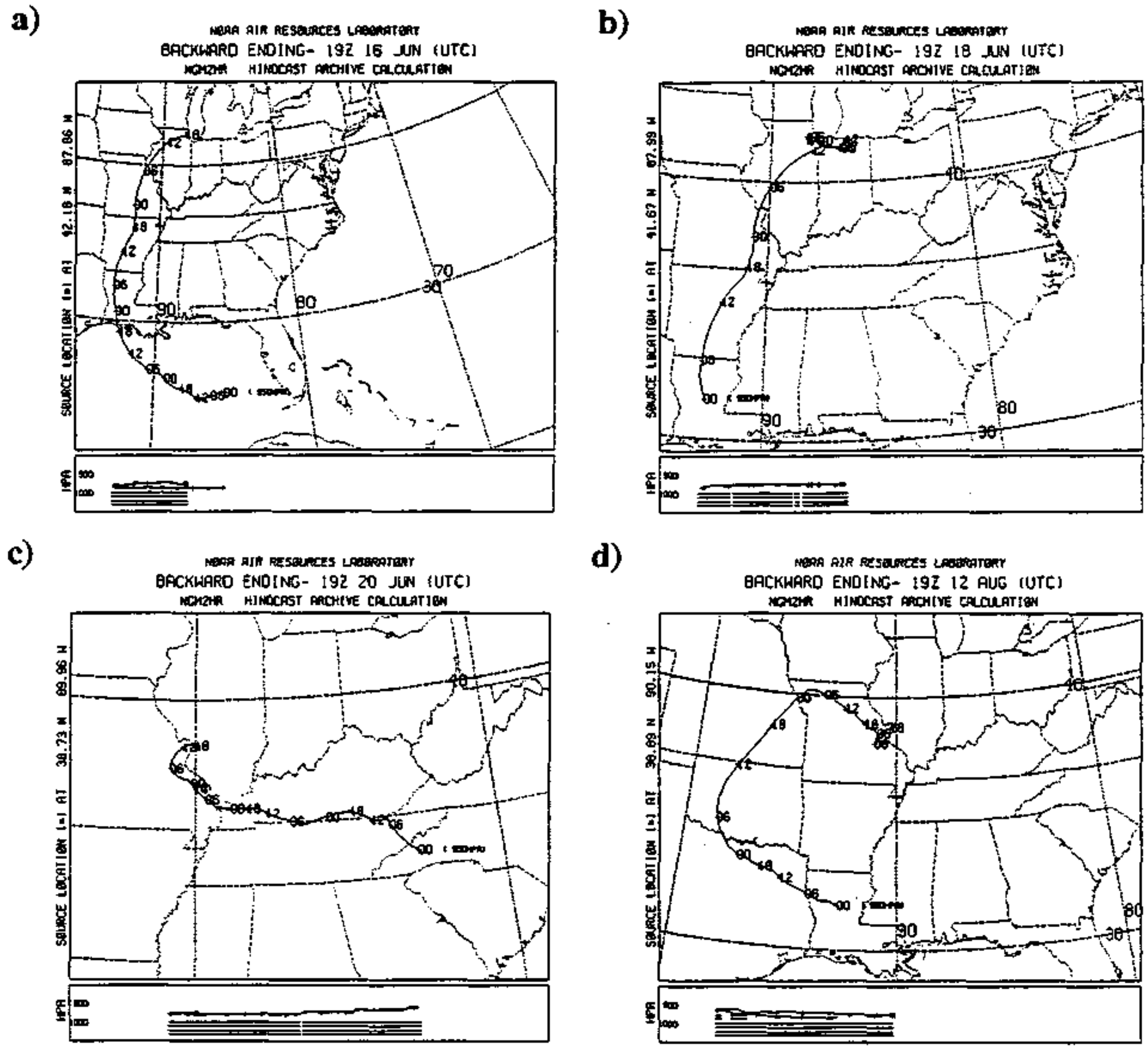

Figure 23. Example back-trajectories from the HY-SPLIT model for four days in 1994 on which the maximum 1-hr ozone concentration exceeded the 0.12 ppm standard at one or more locations in Illinois. Trajectories were computed at the 950 mb level. Trajectory endpoints were: a) Deerfield, 16 June (0.126 ppm); b) Lemont, 18 June (0.169 ppm); c) Maryville, 20 June (0.137 ppm); and d) Alton, 12 August (0.128 ppm).

DISCUSSION

Trends over Time: Increasing, Decreasing, and Level Concentrations

This report covers 15 chemical pollutants for which concentrations in air were typically greater than the analytical detection limit. Some of these are measured over more than one averaging time, resulting in separate treatment of each averaging time. For the full statewide data set, as well as for each of three geographic subregions (Chicago, Metro-East, and the remainder of the state), separate data sets for each of three separate concentration levels (median, 90th percentile, and maximum) were constructed and tested for time trend using the Mann-Kendall nonparametric test. Detailed results of trend tests for 22 separate pollutant-averaging time combinations in four geographical regions and for three concentration levels were presented in table 2. Summaries of the results by pollutant, by geographic region, and by concentration level are given in tables 18-20, respectively.

Table 18 summarizes trend results by pollutant. These are combined results for the Chicago, Metro-East, and Remainder subregions. For CO, Pb, and NO_2, significant downward trends were found in 100% of the testable cases. For ozone, one (11%) of the nine testable cases showed no detectible trend, and the other eight (89%) were downward trends. Two-thirds of the cases had no detectible trend for SO_2, and the other third were downward trends. Forty-four percent of the TSP cases had no detectible trend; the rest (56%) were downward trends. The PM_{10} results were similar: 41% n.s. and 59% downward trends.

Results for NO_3 were similar as well: 43% n.s. and 57% downward trends. Sulfate (SO_4) and arsenic (As) were different, however: 100% downward trends in both cases. Cadmium (Cd) had mostly n.s. (57%), and the rest (43%) downward trends, and chromium (Cr) was evenly split between n.s. and downward trends.

Some upward trends in concentration appear for iron (Fe) and manganese (Mn). Iron had 42% n.s., with the rest of the cases evenly split between upward and downward trends, while manganese had 42% downward trends with the rest evenly split between n.s. and upward trends. Nickel (Ni) trend results were very uniform: 100% n.s. trends.

Table 19 gives results of 66 possible trend tests in each geographic region. In the Chicago region, data were adequate for all 66 tests. In 35% of the cases, no significant trend was found, while significant upward trends were found in 6% of the cases, and downward trends in 59% of the cases. (Throughout this section significance is assessed at the 5% level.) In the Metro-East region, 53 of the 66 cases had adequate data to test. No significant trend was detected in 30% of the 53 cases, no upward trends were found, and 70% of these cases had significant downward trends. The Remainder regions had 44 testable cases; 39% of these had no significant trend, no upward trends were found, and 61% of the cases had downward trends. In the separate statewide database, all 66 cases were testable: 26% had no significant trend, 4% were upward trends, and 70% were downward trends.

Table 18. Summary of Trend Test Results by Pollutant.*

Pollutant	No. of averaging times	No. of possible tests	No. of cases with adequate data to test	Percent of testable cases		
				n.s.**	Upward trend**	Downward trend**
CO	2	18	14	0	0	100
Pb	1	9	8	0	0	100
NO2	3	27	15	0	0	100
Ozone	1	9	9	11	0	89
SO2	3	27	27	67	0	33
TSP	2	18	18	44	0	56
PM-10	2	18	17	41	0	59
NO3	1	9	7	43	0	57
SO4	1	9	7	0	0	100
As	1	9	7	0	0	100
Cd	1	9	7	57	0	43
Cr	1	9	6	50	0	50
Fe	1	9	7	42	29	29
Mn	1	9	7	29	29	42
Ni	1	9	7	100	0	0

Notes:
* Combined results from Chicago, Metro-East, and Remainder regions.
** n.s.=no significant trend. 5% significance level.

Table 19. Summary of Trend Test Results by Geographic Region.

Region	No. of possible tests*	No. of cases with adequate data to test	Percent of testable cases		
			n.s.**	Uptrend**	Downtrend**
Chicago	66	66	35	6	59
Metro-East	66	53	30	0	70
Remainder	66	44	39	0	61
Statewide	66	66	26	4	70

Notes:
* Based on 22 pollutant entities x 3 concentration levels.
** 5% significance level.

Table 20 summarizes results by geographic region and concentration level. For each concentration level (median, 90th percentile, and maximum), the table lists the number of cases with adequate data to perform a trend test and the percent of these cases with no significant (5%) trend and with significant upward trends and downward trends. Please note that, as before, the results for the statewide region are based on a separate statewide database; they are not the sum or average of the results for the three subregions. For *median* concentrations, in all regions, about one-third of the pollutants had no significant trends, and about two-thirds were downward trends, with just a few upward trends found in the Chicago area, as noted earlier.

For the higher *90th percentile* concentrations, the results are more variable region to region. In the Chicago region, the trend results are identical to those for the median concentrations, with about 30% not significant, 10% upward trends, and 60% downward trends. In the Metro-East area, 44% of the cases were not significant, and the rest (56%) were downward trends. In the Remainder area, these percentages were almost reversed: 57% not significant and 43% downward trends. The statewide database yielded about 20% not significant, 10% upward trends, and 70% downward trends.

For *maximum* concentrations, the results are also somewhat variable between regions. No upward trends were found in any of the regions. In the Chicago region the ratio of downward trends to n.s. was about 60% to 40%; in the Metro-East area (as well as statewide) it was almost 80% to 20%, and in the Remainder area it was almost 70% to 30%.

For a given region, there were only minor differences in trend results between concentration levels. Statewide, maximum concentrations had the highest percentage of downward trends (77%), followed by the 90th percentile concentrations (68%) and by medians (64%). Also statewide, the 90th percentile concentrations had the highest percentage of upward trends (9%), followed by the medians (4%) and the maximums (0%). Again statewide, the percentage of cases with no significant trend varied from 32% for median concentrations to 23% for both 90th percentile and maximum concentrations. Only the Remainder region had a concentration level (90th percentile) where the percentage of cases that were not significant exceeded the downward trends.

It should be noted that the trends discussed in this report were computed from all available data, which, for most pollutants, implies a data period of 1978-1994. Visual inspection of figures 1-22 provides many examples where the overall 17-year trend is downward, but the trend during the last 5-10 years appears to be level or even upward. This "leveling off' appears to occur more frequently among the medians; the higher concentration levels appear to be continuing to decline in most cases. Future work on trends of Illinois pollutant concentrations should attempt to quantify the most recent 5-10 year trends in all geographic areas.

Table 20. Summary of Trend Analysis Results by Concentration Level.

Region	Median: No. of testable cases	Median: Percent n.s.	Median: Percent uptrend	Median: Percent downtrend	90th percentile: No. of testable cases	90th percentile: Percent n.s.	90th percentile: Percent uptrend	90th percentile: Percent downtrend
Chicago	22	32	9	59	22	32	9	59
Metro-East	22	32	0	68	9	44	0	56
Remainder	19	37	0	63	7	57	0	43
Statewide	22	32	4	64	22	23	9	68

Region	Maximum: No. of testable cases	Maximum: Percent n.s.	Maximum: Percent uptrend	Maximum: Percent downtrend
Chicago	22	41	0	59
Metro-East	22	23	0	77
Remainder	18	33	0	67
Statewide	22	23	0	77

Comparison of Current Results with CTAP-I Results

Did the additional four years of data and use of a different statistical method produce trends different from those found during CTAP-I? This question is addressed separately in terms of criteria and noncriteria pollutants, as in the CTAP-I report (IDENR, 1994). It should be noted that the particulate matter standard has changed recently. The previous report considered only TSP, which at the time was still a state standard (but no longer a federal standard). Trends for PM_{10} were not computed in that report, since its data record was only a few years long, even though it was the basis for the federal particulate matter standard. The particulate matter standard used in this report is PM_{10}, for which current state and federal standards are written in terms of both annual mean and 24-hr maximum values.

Results are compared here in terms of the previous conclusions (IDENR, 1994) regarding temporal trends of criteria and noncriteria pollutants. Previously, the only trends computed were those of the statewide or regional *median* pollutant concentration, so this comparison can only be made in terms of statewide or regional medians. The significance level referred to below was 5 percent in both studies.

Criteria pollutants. The first conclusion of the previous report was that, for all *criteria* pollutants, only downward trends or no significant trends were found, either statewide or in any geographical region. *The same result was found for the longer data set examined at this time.*

Previously, seven of twelve pollutants statewide had significant downward trends, and Pb had the largest value, -20.5% per year. *In this report, ten of twelve had significant downward trends, and again Pb had the largest value, -16.3% per year.*

Previously, in the Chicago region, eight of twelve pollutants had significant downward trends, and Pb had the largest value, -21.2% per year. *In this report, eleven of twelve had significant downward trends, and Pb again had the largest value, -16.6% per year.*

Previously, in the Metro-East region, only Pb out of four pollutants with adequate data to test had a significant downward trend, -12.6% per year. *In this report, ten of twelve pollutants had significant downward trends, and Pb had the largest, at -11.5% per year.*

Previously, in the Remainder region, three of nine pollutants had significant downward trends, Pb having the largest, at -24.8% per year. *In this report, five of nine pollutants had significant downward trends, and Pb had the largest, at -19.4% per year.*

Noncriteria pollutants. In the 1994 report, trends were computed for eight species in four geographical areas, less two species that had inadequate data, for a total of 30 tests. Twenty of these 30 tests showed no significant trend. *In this report, data were adequate for ten species (including annual mean and 24-hr maximum TSP) in four areas, for a total of 40 tests, and only 19 of these showed no significant trend.*

Previously, for the statewide region, sulfate and arsenic had significant downward trends, and there were no significant upward trends. *Currently, there were significant downward trends again for sulfate and arsenic, but also for nitrate and chromium, and iron was found to have a significant upward trend.*

Previously, for the Chicago region, sulfate and arsenic had significant downward trends. *In this report, sulfate and arsenic again had significant downward trends, and iron and manganese had significant upward trends.*

Previously, for the Metro-East region, iron and manganese had significant upward trends. *Currently, there were no upward trends, but rather significant downward trends for 24-hr mean TSP, nitrate, sulfate, arsenic, and cadmium.*

Previously, for the Remainder region, we found significant downward trends for sulfate, arsenic, cadmium, and manganese. *Currently, there were significant downward trends for these same four species, as well as for 24-hr maximum and annual mean TSP and chromium.*

In general, the previous results showing pollutant concentrations either trending down or remaining constant have been confirmed. Indeed, the current results show additional pollutants with significant downward trends. However, current results show *upward trends* for iron statewide and in the Chicago area, and for manganese in the Chicago area, whereas previously the iron and manganese upward trends were found only in the Metro-East area.

Correlations between Regions

Correlations between the three Illinois subregions were calculated as a measure of spatial homogeneity in pollutant concentration trends. A summary of results of the correlation analyses between regions is given in table 21, which shows the number of correlations coefficients >0.700 (the bold values in table 3) by regional pair and concentration level. The total number of possible correlations (n) is also given and emphasizes that many fewer correlations were possible in the case of the 90th percentile values due to inadequate numbers of sampling sites. Because of the wide disparity in total numbers of correlations, total high correlations for each concentration level are shown in terms of the percent of total correlations calculated, as well as by total count.

The medians and 90th percentile values had highest percentages of correlations >0.700, 27% and 26%, respectively, with maximums somewhat lower at 18%. With fewer than 30% of the correlations at all concentration levels >0.700, it is evident that there is considerable variability in pollutant time histories, at all concentration levels, from region to region. Thus, neither regional weather conditions nor uniform national control measures are dominant influences on pollutant time histories; local influences appear to be more important.

It is also possible to compare results in terms of the number of correlations >0.700 for each pair of regions. The Metro-East/Remainder pair had the most high correlations, with 16.

Table 21. Summary of Results of Correlation Analysis. Number of Correlations >0.700 by Regional Pair and Concentration Level.

Regional pair	Median n	Median Count	90th percentile* n	90th percentile* Count	Maximum n	Maximum Count	Total
Chicago-Metro East	22	2	9	2	22	3	7
Chicago-Remainder	19	7	9	2	19	2	11
Metro East-Remainder	19	7	9	3	19	6	16
Totals	60	16	27	7	60	11	
Percent		27%		26%		18%	

Notes:

* Correlations were not possible for about half of the pollutants because of small numbers of sampling sites.

Chicago/ Remainder was next highest at 11, and the Chicago/Metro-East pair had the fewest high correlations at 7. It is reasonable that the two regions at opposite ends of the state should have the fewest high correlations. It also seems reasonable that of pairs involving adjacent regions, the pair having the greater source region upwind in terms of the prevailing winds (i.e., Metro-East/Remainder) should have more high correlations.

Comparison of Results: Regional Medians vs. Long Duration Individual Sampling Sites

Trend results for regional median pollutant concentrations were compared with those of local long duration individual sampling sites to look for evidence of possible bias due to the preferential closing of "cleaner" sites as the number of sampling sites was reduced over the years. A summary of these comparisons appears in table 22. Results are shown separately for each region. The table lists subjectively determined numbers of observed cases in three categories: good agreement (between percent per year trend values for regional medians and local individual sites), possible bias effect, and opposite to bias effect. A case was considered to show a possible bias effect if the absolute value of the regional trend was substantially less than those of the majority of the individual sites. Cases where the reverse was true were classified as opposite to the bias effect. The table also shows counts of cases where the possible bias effect or the opposite could be explained by differences in record length (i.e., number of years of data).

In the Chicago region the agreement between trend rates was good for 13 pollutants. Three showed a possible bias effect, and five showed differences opposite to those expected from the bias effect. Of the eight with positive or negative indications of bias effect, seven could also be explained by differences in length of the data period between the regional data and the individual sites. In the Metro-East area, 11 pollutants showed good agreement between regional medians and individual trend rates. Seven pollutants showed a possible bias effect, and two showed the opposite effect. Differences in record length might explain two of the cases of apparent bias, and one opposite case, so overall there appears to be evidence of possible bias in the regional trends of a few pollutants in the Metro-East area. The pollutants possibly affected by the bias are annual mean TSP and the annual means of the metals As, Cr, Fe, and Mn.

In the Remainder area, there was good agreement between trends of regional medians and individual sites for 12 pollutants, a possible bias effect for four pollutants, and the opposite effect for one. There were no cases where differences in record length could explain differences indicating a possible bias or the opposite, so again in the Remainder area, there is evidence of possible bias in the regional trends of a few pollutants (3-hr, 24-hr, and annual mean SO_2, and annual mean Fe). Iron is the only pollutant to show a possible bias effect in both the Metro-East and Remainder regions.

Table 22. Results from Comparison of Trend Results: Individual Sites vs. Regional Medians. Counts of Occurrences in Each Region.

	Observation			Explanation:
Region	Good agreement	Possible bias effect	Opposite to bias effect	Difference in record length
Chicago	13	3	5	7
Metro-East	11	7	2	3
Remainder	12	4	1	1
Totals	36	14	8	11

SUMMARY AND CONCLUSIONS

This work updates previous work on Illinois air quality trends. Relative trends were computed for 22 pollutant data sets in four geographic regions and three concentration levels over the period 1978-1994. Statistical significance was tested using the nonparametric Mann-Kendall test for trend.

In general, pollutant concentrations were found to be mostly declining or holding steady over the 17-year data period, confirming the earlier results for a 13-year data period. Trend results are also summarized by pollutant, by geographic region of the state, and by concentration level. The summary by pollutant (table 18) is based on the percent of testable data sets showing significant (5% level) downward trends. The pollutants fell into four general categories: *CO, Pb,* NO_2, SO_4, *and* O_3 had values of the percent of possible downward trends in the 89-100% range; PM_{10}, NO_3, *TSP, and Cr* in the 50-60% range; *Cd, Mn,* SO_2, *and Fe* in the 29-43% range; and *Ni* at 0%.

The number of downward trends exceeded that of no significant trends and especially that of upward trends in all geographic regions. The summary by geographic region (table 19) is based on the percentages of downward trends, upward trends, and no significant trends in the testable data sets among the total number of cases in 22 pollutant entities and three concentration levels. *Statewide,* the three-way ratio of downward trends to upward trends to no trends was roughly 70:5:25. Minor variations from this were observed in the three subregions. The corresponding ratio was 60:5:35 in the *Chicago* area, 70:0:30 in the *Metro-East* area, and 60:0:40 in the *Remainder* area. Note that upward trends were observed only in the Chicago and statewide data.

The summary by concentration level is based on the number of testable cases among the 22 pollutant entities in each geographic area. Statewide, the three-way ratio of downward trends to upward trends to no trends was roughly 65:5:30 for *medians,* 70:10:20 for *90th percentile* values, and 80:0:20 for *maximum* values. Again, minor variations in these ratios occurred in the various subregions, but Chicago was the only one with upward trends.

These trend results confirm, and in fact strengthen, the 1994 results that showed mostly downward trends in pollutant concentrations. For criteria pollutants, both statewide and in each subregion, the fraction of possible cases showing downward trends *increased* over that found in the 13-year data set. The current results show that the highest rates of decline are for Pb, as they were earlier, but the percent per year values for the various regions are now somewhat lower. This would be expected, since the concentrations have largely leveled off, and the overall declines are now averaged over more years of data. For noncriteria pollutants, the fraction of data sets with significant trends increased from the one-third found earlier to one-half now. The current results show additional pollutants with downward trends statewide, as well as in the Metro-East and Remainder regions. Upward trends (for iron and manganese) are now found only in the Chicago area, whereas previously they were found only in the Metro-East area.

Correlations between the three Illinois subregions were calculated as a measure of spatial homogeneity in concentration trends. Fewer than 30% of the correlations over all regions and concentration levels exceeded 0.700, indicating considerable variability in pollutant time histories from region to region. Local influences appear to dominate over regional weather conditions and uniform federal control measures in determining regional pollutant concentrations.

Trends computed for regional medians were compared with trends at individual long duration sites to look for possible bias in the regional trends. Bias seemed possible due to preferential closing of low-concentration sites as the sampling network was reduced over the years. These comparisons were qualitative and subjective. In each region, good agreement between regional and individual site trends was observed in more than half of the cases. In the Chicago region, a possible bias effect was seen in three of 21 cases, while differences opposite to the bias effect occurred in five cases. In seven of these eight cases, the differences appear to be related to differences in the length of the data record. In the Metro-East and Remainder regions, the numbers of possible bias effect cases exceeded those opposite to the bias effect, and only a few cases could be explained by differences in the length of the data record. Overall, there is weak evidence for a bias effect for a few pollutants in the Metro-East and Remainder areas, but not in the Chicago area.

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APPENDIX 1. Results of Mann-Kendall Tests.

Statistic	Medians				90th percentile values				Maximums			
	State-wide	Chicago	Metro-East	Remainder	State-wide	Chicago	Metro-East	Remainder	State-wide	Chicago	Metro-East	Remainder
CO, maximum 1-hr mean (n=17)												
Kendall Statistic (S)	-80	-57	-81	-85	-108	-94	0	0	-99	-101	-96	-50
Mean Annual Trend (ppm/yr)	-0.33095	-0.23224	-0.41407	-0.42893	-0.70882	-0.94480	0.00000	0.00000	-0.87844	-1.01630	-0.76015	-0.38851
Probability	<0.000	0.010	<0.000	<0.000	<0.000	<0.000			<0.000	<0.000	<0.000	0.021
CO, maximum 8-hr mean (17)												
Kendall Statistic (S)	-76	-59	-95	-85	-82	-85	0	0	-78	-94	-102	-59
Mean Annual Trend (ppm/yr)	-0.20845	-0.15409	-0.27553	-0.26748	-0.33833	-0.49781	0.00000	0.00000	-0.47380	-0.56366	-0.41529	-0.17527
Probability	0.001	0.008	<0.000	<0.000	<0.000	<0.000			0.000	<0.000	<0.000	0.008
Annual mean Pb ug/M3 (16)							(11)					
Kendall Statistic (S)	-102	-102	-106	-102	-107	-103	-82	0	-112	-100	-112	-109
Mean Annual Trend (ug/m3/yr)	-0.02505	-0.02599	-0.03309	-0.01784	-0.03636	-0.03843	-0.07176	0.00000	-0.16127	-0.05445	-0.16089	-0.02827
Probability	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000		<0.000	<0.000	<0.000	<0.000
NO_2, maximum 1-hr mean (17)			(13)		(14)	(13)					(13)	
Kendall Statistic (S)	-95	-97	-38	0	-63	-52	0	0	-75	-75	-40	0
Mean Annual Trend (ppm/yr)	-0.00461	-0.00600	-0.00426	0.00000	-0.01199	-0.01058	0.00000	0.00000	-0.01050	-0.01050	-0.00472	0.00000
Probability	<0.000	<0.000	0.011		<0.000	0.000			0.001	0.001	0.007	
NO_2, maximum 24-hr mean (17)			(13)								(13)	
Kendall Statistic (S)	-86	-83	-32	0	-106	-106	0	0	-111	-111	-45	0
Mean Annual Trend (ppm/yr)	-0.00272	-0.00269	-0.00113	0.00000	-0.00562	-0.00575	0.00000	0.00000	-0.00780	-0.00780	-0.00214	0.00000
Probability	<0.000	<0.000	0.029		<0.000	<0.000			<0.000	<0.000	0.002	
NO_2, annual mean (17)			(13)								(13)	
Kendall Statistic (S)	-81	-81	-32	0	-110	-106	0	0	-109	-109	-32	0
Mean Annual Trend (ppm/yr)	-0.00152	-0.00143	-0.00002	0.00000	-0.00187	-0.00186	0.00000	0.00000	-0.00233	-0.00233	-0.00006	0.00000
Probability	<0.000	<0.000	0.029		<0.000	<0.000			<0.000	<0.000	0.029	
O_3, maximum 1-hr mean (17)												
Kendall Statistic (S)	-60	-62	-59	-33	-64	-64	-58	-48	-59	-50	-59	-47
Mean Annual Trend (ppm/yr)	-0.00161	-0.00213	-0.00205	-0.00080	-0.00358	-0.00466	-0.00274	-0.00124	-0.00406	-0.00426	-0.00277	-0.00193
Probability	0.007	0.005	0.008	0.095	0.004	0.004	0.009	0.026	0.008	0.021	0.008	0.029
SO_2, maximum 3-hr mean (17)							(14)	(17)				
Kendall Statistic (S)	-34	-84	22	21	-24	-46	-13	-38	8	-33	-3	-35
Mean Annual Trend (ppm/yr)	-0.00108	-0.00323	0.00193	-0.00122	-0.00220	-0.00441	-0.00393	-0.00373	0.00049	-0.00611	-0.00161	-0.00463
Probability	0.088	<0.000	0.196	0.208	0.174	0.032	0.259	0.064	0.388	0.095	0.468	0.082

APPENDIX 1. Results of Mann-Kendall Tests (continued).

	Medians				90th percentile values				Maxmums			
Statistic	State-wide	Chicago	Metro-East	Remainder	State-wide	Chicago	Metro-East	Remainder	State-wide	Chicago	Metro-East	Remainder
SO2, maximum 24-hr mean (17)							(14)	(17)				
Kendall Statistic (S)	-55	-68	-18	-22	-4	-39	-13	-26	-11	-36	-32	-24
Mean Annual Trend (ppm/yr)	-0.00103	-0.00166	-0.00098	-0.00069	-0.00052	-0.00076	-0.00357	-0.00105	-0.00088	-0.00317	-0.00301	-0.00100
Probability	0.012	0.002	0.245	0.196	0.452	0.059	0.259	0.154	0.343	0.076	0.102	0.174
SO2, annual mean (17)							(13)	(17)				
Kendall Statistic (S)	-89	-80	-86	-40	-78	-76	-61	-20	-95	-71	-108	-33
Mean Annual Trend (ppm/yr)	-0.00023	-0.00026	-0.00053	-0.00024	-0.00038	-0.00044	-0.00080	-0.00018	-0.00065	-0.00052	-0.00074	-0.00020
Probability	<0.000	<0.000	<0.000	0.054	0.000	0.001	<0.000	0.220	<0.000	0.002	<0.000	0.095
24-hr maximum TSP ug/M3 (16)							(13)	(16)				
Kendall Statistic (S)	-20		7 - 4	5 - 4 3	6	9	-32	4	-58	-50	-88	-17
Mean Annual Trend (ug/m3/yr)	-2.26998	-1.09410	-3.79238	-3.13836	-0.56364	0.53116	-16.46642	1.96203	-29.366	-18.5356	-37.4959	-7.90433
Probability	0.199	0.395	0.024	0.029	0.412	0.362	0.029	0.447	0.004	0.013	<0.000	0.239
Annual mean TSP ug/M3 (16)							**(11)**	(15)				
Kendall Statistic (S)	-26	-16	-28	-53	-11	2	-21	-46	-70	-49	-74	-68
Mean Annual Trend (ug/m3/yr)	-0.67835	-0.26088	-1.10030	-1.25865	-0.61181	0.18324	-3.88080	-0.48560	-6.47639	-2.11915	-6.88228	-3.18194
Probability	0.133	0.253	0.114	0.009	0.329	0.482	0.060	0.012	<0.000	0.014	<0.000	<0.000
Annual mean nitrate ug/M3 (17)												
Kendall Statistic (S)	-47	-28	-42	-30	-72	-60	0	0	-84	-84	-53	-38
Mean Annual Trend (ug/m3/yr)	-0.04341	-0.02622	-0.05044	-0.03880	-0.07823	-0.07672	0.00000	0.00000	-0.12299	-0.12299	-0.08021	-0.09619
Probability	0.029	0.135	0.046	0.118	0.001	0.007			<0.000	<0.000	0.019	0.064
Annual mean sulfate ug/M3 (17)												
Kendall Statistic (S)	-61	-57	-46	-59	-60	-48	0	0	-68	-68	-59	-78
Mean Annual Trend (ug/m3/yr)	-0.10145	-0.11178	-0.10653	-0.10820	-0.15399	-0.13956	0.00000	0.00000	-0.30058	-0.32437	-0.28265	-0.30315
Probability	0.006	0.010	0.032	0.008	0.007	0.026			0.002	0.002	0.008	0.000
Annual mean As ug/M3 (17)						(13)						
Kendall Statistic (S)	-61	-69	-62	-74	-67	-28	0	0	-101	-49	-102	-45
Mean Annual Trend (ug/m3/yr)	-0.00010	-0.00009	-0.00025	-0.00010	-0.00033	-0.00026	0.00000	0.00000	-0.00184	-0.00085	-0.00184	-0.00019
Probability	0.006	0.002	0.005	0.001	0.002	0.050			<0.000	0.024	<0.000	0.035
Annual mean Cd ug/M3 (16)						(12)						
Kendall Statistic (S)	-20	-5	-63	-70	-47	10	0	0	-32	6	-16	-88
Mean Annual Trend (ug/m3/yr)	-0.00005	-0.00003	-0.00034	-0.00010	-0.00018	0.00003	0.00000	0.00000	-0.00049	-0.00039	-0.00020	-0.00074
Probability	0.199	0.430	0.002	0.001	0.018	0.273			0.083	0.412	0.253	<0.000

APPENDIX 1. Results of Mann-Kendall Tests (concluded).

Statistic	Medians				90th percentile values				Maximums			
	State-wide	Chicago	Metro-East	Remainder	State-wide	Chicago	Metro-East	Remainder	State-wide	Chicago	Metro-East	Remainder
Annual mean Cr ug/M3 (10)						(9)						
Kendall Statistic (S)	-23	-12	-16	-21	-25	-26	0	0	-31	-18	-24	0
Mean Annual Trend (ug/m3/yr)	-0.00056	-0.00023	-0.00078	-0.00019	-0.00124	-0.00209	0.00000	0.00000	-0.00233	-0.00114	-0.00193	0.00000
Probability	0.023	0.168	0.093	0.036	0.014	0.003			0.002	0.066	0.018	
Annual mean Fe ug/M3 (17)												
Kendall Statistic (S)	44	71	26	-23	70	72	0	0	-58	17	-58	-75
Mean Annual Trend (ug/m3/yr)	0.01046	0.03367	0.02435	-0.00925	0.06490	0.06520	0.00000	0.00000	-0.47521	-0.03055	-0.47670	-0.06783
Probability	0.038	0.002	0.154	0.185	0.002	0.001			0.009	0.304	0.009	0.001
Annual mean Mn ug/M3 (17)												
Kendall Statistic (S)	-17	42	18	-85	74	76	0	0	-60	-35	-56	-86
Mean Annual Trend (ug/m3/yr)	-0.00033	0.00074	0.00301	-0.00154	0.00741	0.00961	0.00000	0.00000	-0.05215	-0.01206	-0.05350	-0.00608
Probability	0.258	0.046	0.245	<0.000	0.001	0.001			0.007	0.082	0.011	<0.000
Annual mean Ni ug/M3 (11)						(9)						
Kendall Statistic (S)	16	21	8	19	15	4	0	0	12	18	7	9
Mean Annual Trend (ug/m3/yr)	0.00035	0.00047	0.00017	0.00040	0.00046	0.00010	0.00000	0.00000	0.00035	0.00088	0.00001	0.00045
Probability	0.125	0.060	0.298	0.082	0.141	0.381			0.201	0.096	0.324	0.271
Annual mean PM10 ug/M3 (8)							(6)					
Kendall Statistic (S)	-21	-15	-20	-19	-20	-10	-13	0	-18	0	-16	-22
Mean Annual Trend (ug/m3/yr)	-1.52364	-0.72649	-2.19303	-1.78669	-3.17666	-0.62297	-6.47744	0.00000	-4.34031	0.02628	-4.58827	-4.02296
Probability	0.005	0.042	0.007	0.011	0.007	0.138	0.008		0.016	0.548	0.031	0.002
24-hr maximum PM10 ug/M3 (8)							(6)	(7)				
Kendall Statistic (S)	-14	-4	-18	-13	-20	-2	-7	-13	-10	-3	0	-20
Mean Annual Trend (ug/m3/yr)	-3.01582	0.40816	-5.11552	-3.79503	-9.74172	-6.27495	-10.18789	-13.79667	-9.89762	-6.77993	-1.13869	-15.80672
Probability	0.054	0.360	0.016	0.0715	0.007	0.452	0.136	0.035	0.138	0.406	0.548	0.007

Notes:

n is the number of sampling sites in the data set tested. It is given in parentheses following the pollutant name and units, and is the same for all areas and concentration levels, unless another value is shown for a particular data set.

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