MEMORANDUM

SUBJECT: Investigation of How Distributions of Hourly Sulfur Dioxide
Concentrations Have Changed Over Time in Six Cities

FROM: Michael Rizzo, Air Quality Analysis Group

TO: Sulfur Dioxide NAAQS Review Docket (EPA–HQ–OAR–2007–
0352)

DATE: March 16, 2009

For the current review of the sulfur dioxide (SO_2) National Ambient Air Quality
Standards (NAAQS), I have compared the distributions of daily maximum hourly SO_2
concentration values for years with low and high ambient air concentrations to determine
how these distributions have changed over time at monitors within seven counties across
the United States. Understanding these historical changes is relevant to creating
estimates of what air quality for SO_2 would be if air quality deteriorated or improved to
just meet potential NAAQS standards being analyzed in the risk and exposure assessment
for SO_2.

For each of the counties (Hillsborough County FL, Green County MO, Iron County MO,
Cuyahoga County OH, Allegheny County PA, Beaver County PA, and Jefferson County
TX), SO_2 data were taken from the Air Quality System (AQS) on September 10, 2008 for
year priors to and including 2007. The most recent year of 2007 was used as the low
concentration year and compared to a high concentration year which was selected from
years prior to 2007 as described below.

Completeness criteria were applied to data from each year to determine which sites
within each city would be used in the analysis. Sites had to have at least 75% of the
hourly values within a sampled day for the day to be considered complete. Each quarter
had to have at least 75% valid days to be complete and all four quarters had to be
complete across the year for the site to be retained. Any sites without complete data for
2007 were eliminated. Among the sites which are complete for 2007, monitoring records
were then examined to determine which earlier years had complete data. The earliest
year in which all retained sites had complete data was used as the high concentration year
for that county. Thus, all valid sites within a specific county utilized the same years of
data for consistency purposes.

For each site within a county, pairs of points on the low and high year distributions were selected at percentiles ranging from 0% to 100% with 1% increments. Figures 1 through 7 display these paired points by monitoring site, visualizing the relationship between the low and high year distributions for complete sites within each county. A line representing the linear fit of the data is also displayed along with the correlation coefficient characterizing the quality of the fit and the linear equation of the fit. The slope of the fit line is rounded to two decimal places, while the intercept is rounded to three. Plots not showing a value for the intercept mean that the value rounded to zero.

Overall, the majority of sites across the seven counties exhibit a strong linear relationship between the low and high year distributions. In some cases, specific observations at individual sites deviate from linearity to varying degrees either at the extreme upper or lower ends of the distributions. Obviously noticeable deviations from the linear fit at most sites are limited to the extreme upper end of the distribution at values usually greater than the 95th percentile.

In the majority of the monitor cases, the y-intercept of the best fit line is within plus or minus a few parts per billion. There are a few cases where the absolute value of the intercept is greater than a few parts per billion. A positive intercept indicates a percentage larger decline between high and low year concentrations in the upper end of the distribution than in the middle and lower percentiles. The positive intercept adds a constant value to the proportionally reduced individual concentrations across the distribution. The size of that offset will be larger relative to the concentrations at the lower end of the distribution and smaller relative to the concentrations at the upper end of the distribution. Hence, a linear relationship with a positive intercept will cause concentrations on the distribution's upper end to be reduced by a larger percentage between the high and low years as opposed to concentrations in the middle and lower parts of the distribution. Similarly, a linear relationship with a negative intercept will cause a larger change to values in the middle and lower parts of the distribution than at the upper end.

For the results shown from the seven counties, some of the points in the upper end of the distribution are above the best fit line. When this is the case, it means that the percentile point has not declined as much as the middle of the distribution. For many cases, the slope for the relationship between the low and high years is one or greater meaning that there was a broadly applicable increase in SO_2 concentrations between the two years.

Figure 1. Comparison of low to high year daily max hourly SO₂ concentration distributions for sites within Hillsborough County FL
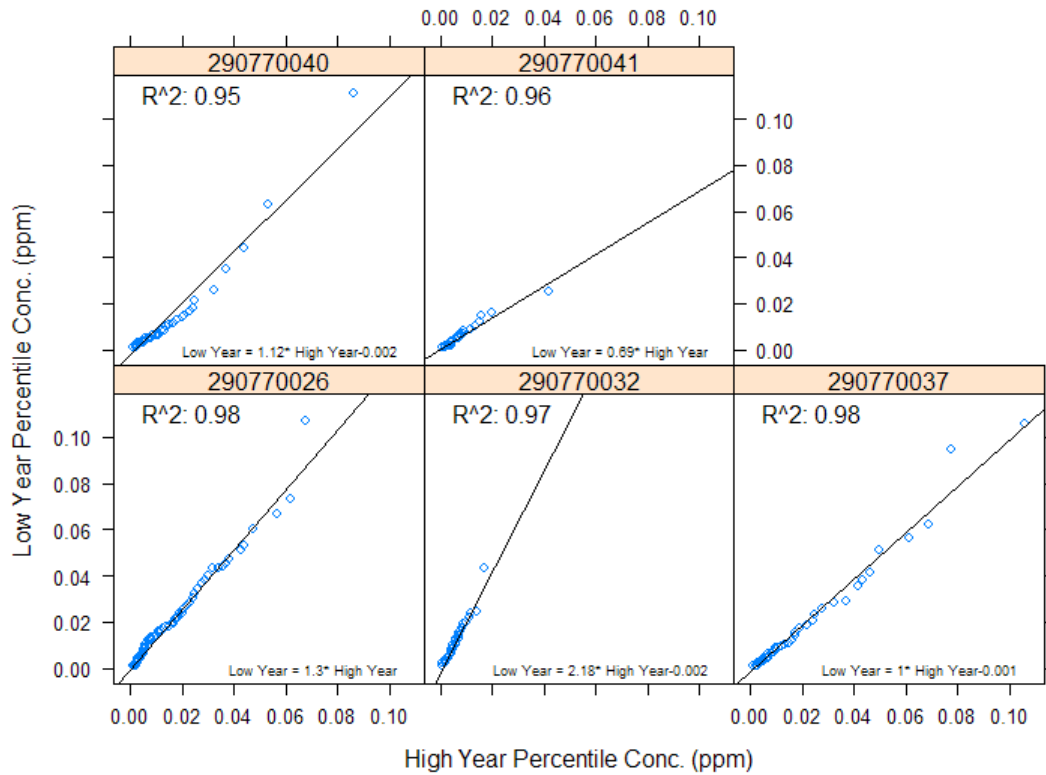
Figure 2. Comparison of low to high year daily max hourly SO₂ concentration distributions for sites within Green County MO

High Year: 1997 Low Year: 2003

Figure 3. Comparison of low to high year daily max hourly SO₂ concentration distributions for a site within Iron County MO

Figure 4. Comparison of low to high year daily max hourly SO₂ concentration distributions for a site within Cuyahoga County OH
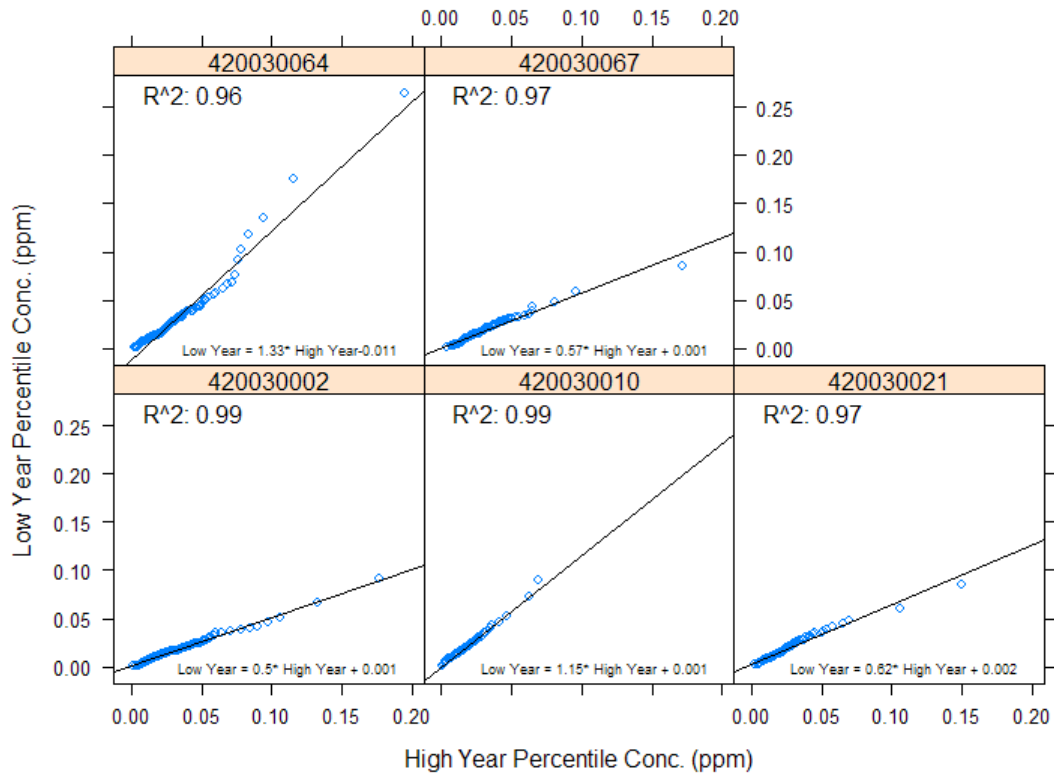
Figure 5. Comparison of low to high year daily max hourly SO$_2$ concentration distributions for sites within Allegheny County PA

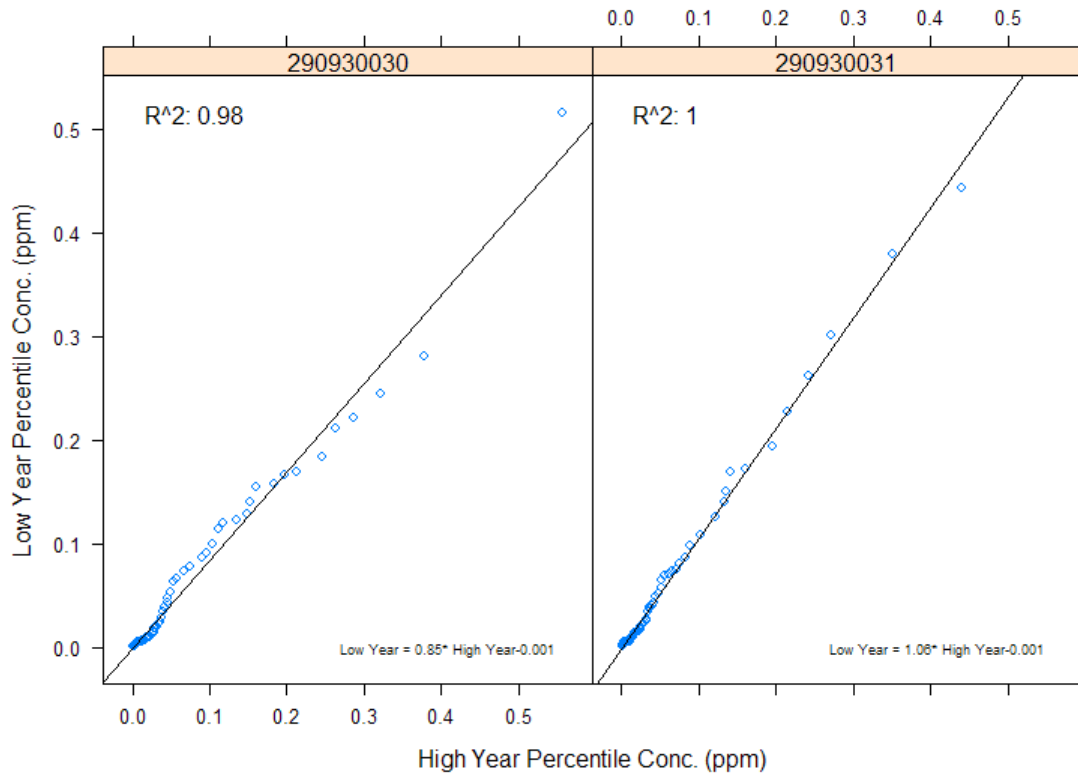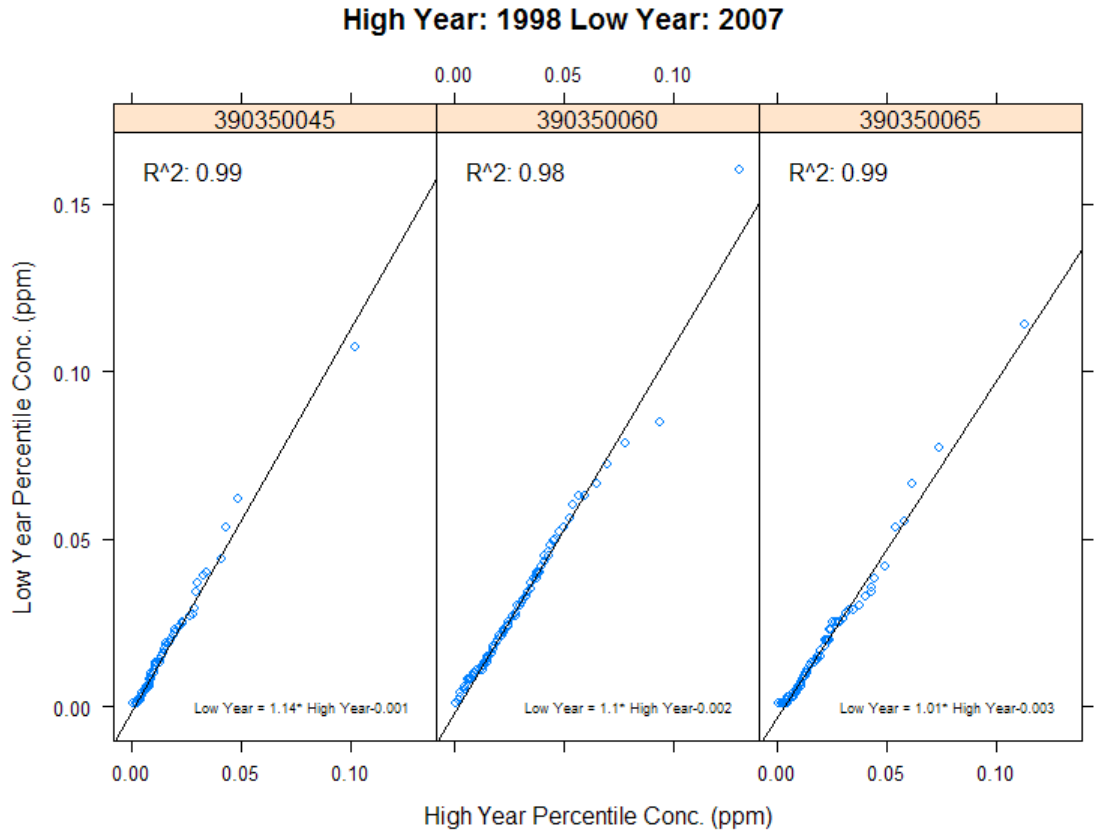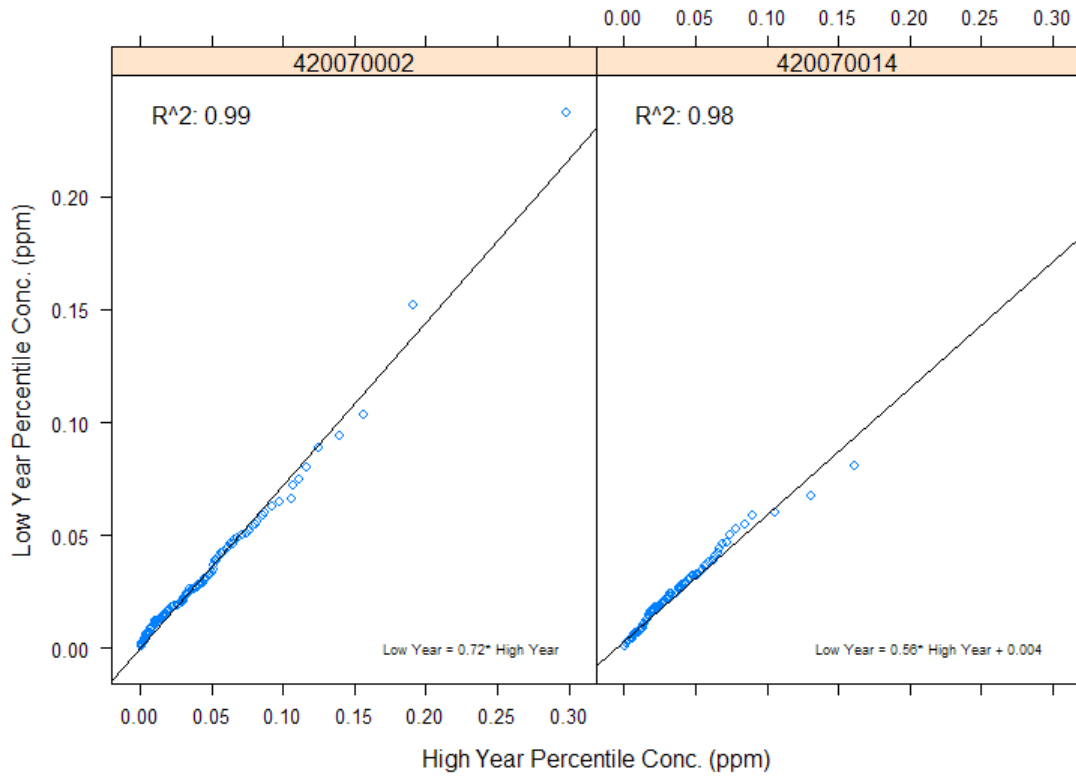**Figure 6.** Comparison of low to high year daily max hourly SO$_2$ concentration distributions for sites within Beaver County PA
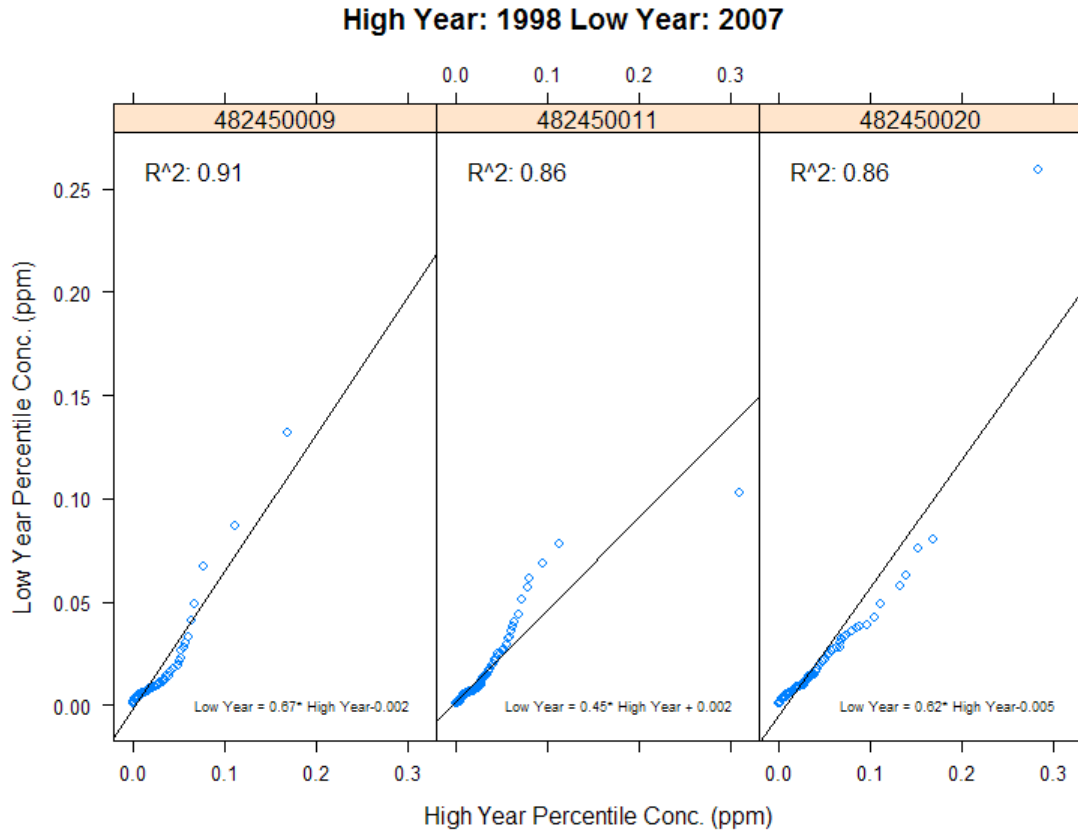
Figure 7. **Comparison of low to high year daily max hourly SO$_2$ concentration distributions for sites within Jefferson County TX**

An additional analysis was done to determine whether or not the relationship between high and low year SO$_2$ concentrations remained consistent when examining the distributions from a subset of high and low years for the sites analyzed above. The three most complete low concentration years and the three most complete high concentration years which were unique to each site were paired to give nine combinations of low to high year comparisons with each comparison fitted to a linear model. An example of the nine possible pairings is presented in Figure 8 for a site used in Hillsborough County FL. For this particular site, the general slope of the relationship between the low and high concentration years is not sensitive to the choice of the high and low years. The studentized residuals were computed and compared to a students t distribution at a significance level of 10%. Points significant at the 10% level for each site and pair of years are listed in Tables 1 through 7. Highlighted entries within the tables correspond to site-year pairs appearing in Figures 1 through 7.

The corresponding slope, intercept, and R^2 for each comparison as well as the individual point's percent of the total error in the model are also listed. In general, an R^2 greater than 0.95 showed the data fit a linear model well across the entire span of the distribution. Values at the extreme upper end of the distribution tended to deviate more from linearity when the R^2 was between 0.9 and 0.94, while the middle part of the distribution remained

linear. When the R^2 fell below 0.9, the relationship between the low and high year distributions appeared to depend more on the role outliers played at specific sites in determining the R^2 with the remainder of the data being fit well by the linear model. The overall quality of the fit between the low and high years also appeared to be more dependent on the site rather than the area.

Figure 8. Example of the Low to High Year Comparisons for a Monitor within Hillsborough County FL

Table 1: Listing of Regression Statistics and Significant Outliers for Low to High Year SO$_2$ Comparisons at Sites within Hillsborough County, FL

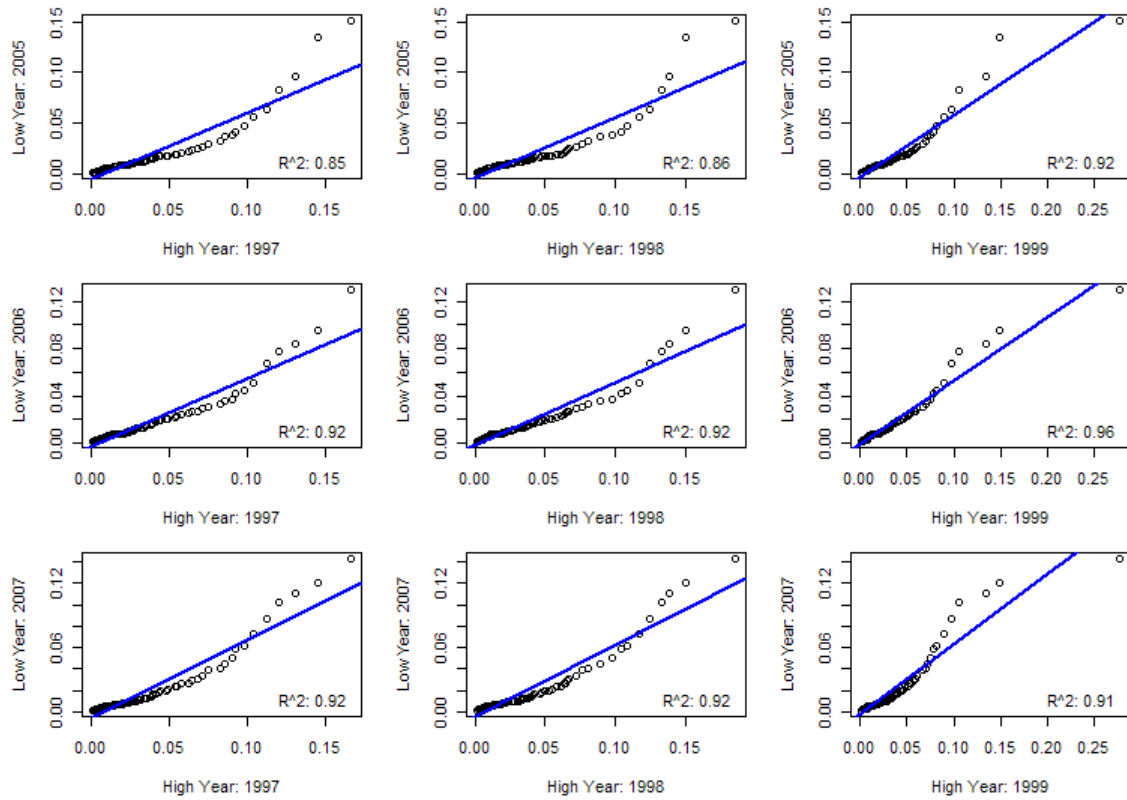| Site	High Year	Low Year	R^2	Intercept	Slope	Percentile	Percent of SSE
120570081	1977	2005	0.96	0.002	0.26	97	26
120570081	1977	2005	0.96	0.002	0.26	100	22
120570081	1992	2005	0.98	0.002	0.24	97	21
120570081	1992	2005	0.98	0.002	0.24	100	23
120570081	1993	2005	0.87	0.001	0.29	97	13
120570081	1993	2005	0.87	0.001	0.29	100	62
120570081	1977	2006	0.82	0.000	0.31	98	11
120570081	1977	2006	0.82	0.000	0.31	100	56
120570081	1992	2006	0.85	−0.001	0.29	99	10
120570081	1992	2006	0.85	−0.001	0.29	100	55
120570081	1993	2006	0.64	0.000	0.32	100	76
120570081	1977	2007	0.98	0.002	0.24	97	22
120570081	1977	2007	0.98	0.002	0.24	98	10
120570081	1977	2007	0.98	0.002	0.24	100	17
120570081	1992	2007	0.99	0.002	0.22	97	11
120570081	1992	2007	0.99	0.002	0.22	99	23
120570081	1992	2007	0.99	0.002	0.22	100	16
120570081	1993	2007	0.90	0.001	0.27	97	12
120570081	1993	2007	0.90	0.001	0.27	100	65
120570095	1982	2005	0.78	−0.003	0.28	99	13
120570095	1982	2005	0.78	−0.003	0.28	100	34
120570095	1983	2005	0.83	−0.004	0.30	99	16
120570095	1983	2005	0.83	−0.004	0.30	100	29
120570095	1984	2005	0.89	−0.002	0.26	99	12
120570095	1984	2005	0.89	−0.002	0.26	100	27
120570095	1982	2006	0.93	0.000	0.13	100	30
120570095	1983	2006	0.96	−0.001	0.14	99	12
120570095	1983	2006	0.96	−0.001	0.14	100	23
120570095	1984	2006	0.98	0.000	0.12	100	18
120570095	1982	2007	0.96	0.000	0.13	100	48
120570095	1983	2007	0.98	−0.001	0.14	100	45
120570095	1984	2007	0.99	0.000	0.12	99	26
120570095	1984	2007	0.99	0.000	0.12	100	31
120570109	1997	2005	0.85	−0.005	0.65	99	23
120570109	1997	2005	0.85	−0.005	0.65	100	26
120570109	1998	2005	0.86	−0.004	0.59	99	28
120570109	1998	2005	0.86	−0.004	0.59	100	23
120570109	1999	2005	0.92	−0.003	0.61	97	10
120570109	1999	2005	0.92	−0.003	0.61	99	46
120570109	1997	2006	0.92	−0.003	0.58	100	38
120570109	1998	2006	0.92	−0.002	0.53	99	10
120570109	1998	2006	0.92	−0.002	0.53	100	34
120570109	1999	2006	0.96	−0.001	0.54	96	14
120570109	1999	2006	0.96	−0.001	0.54	97	25
120570109	1999	2006	0.96	−0.001	0.54	99	16
120570109	1999	2006	0.96	−0.001	0.54	100	17
120570109	1997	2007	0.92	−0.006	0.73	100	13
120570109	1998	2007	0.92	−0.004	0.67	98	10
120570109	1998	2007	0.92	−0.004	0.67	99	12
120570109	1998	2007	0.92	−0.004	0.67	100	10

Table 1: Listing of Regression Statistics and Significant Outliers for Low to High Year SO_2 Comparisons at Sites within Hillsborough County, FL

Site	High Year	Low Year	R^2	Intercept	Slope	Percentile	Percent of SSE
120570109	1999	2007	0.91	−0.003	0.66	96	10
120570109	1999	2007	0.91	−0.003	0.66	97	20
120570109	1999	2007	0.91	−0.003	0.66	98	10
120570109	1999	2007	0.91	−0.003	0.66	99	11
120570109	1999	2007	0.91	−0.003	0.66	100	21
120571035	1975	2005	0.92	−0.001	0.20	99	14
120571035	1975	2005	0.92	−0.001	0.20	100	41
120571035	1976	2005	0.97	−0.001	0.32	98	12
120571035	1976	2005	0.97	−0.001	0.32	100	20
120571035	1977	2005	0.99	0.002	0.34	98	23
120571035	1977	2005	0.99	0.002	0.34	99	13
120571035	1977	2005	0.99	0.002	0.34	100	9
120571035	1975	2006	0.77	−0.002	0.23	100	83
120571035	1976	2006	0.85	−0.003	0.39	100	74
120571035	1977	2006	0.91	0.000	0.43	99	28
120571035	1977	2006	0.91	0.000	0.43	100	53
120571035	1975	2007	0.79	−0.002	0.19	100	77
120571035	1976	2007	0.87	−0.002	0.32	100	70
120571035	1977	2007	0.95	0.000	0.35	99	22
120571035	1977	2007	0.95	0.000	0.35	100	59

Table 2: Listing of Regression Statistics and Significant Outliers for Low to High Year SO$_2$ Comparisons at Sites within Greene County, MO

Site	High Year	Low Year	R^2	Intercept	Slope	Percentile	Percent of SSE
290770026	1979	2005	0.89	0.005	0.17	100	13
290770026	1980	2005	0.95	0.004	0.28	98	10
290770026	1980	2005	0.95	0.004	0.28	99	14
290770026	1981	2005	0.97	0.002	0.21	100	45
290770026	1979	2006	0.86	0.006	0.20	100	14
290770026	1980	2006	0.93	0.004	0.34	98	10
290770026	1980	2006	0.93	0.004	0.34	99	14
290770026	1981	2006	0.95	0.003	0.25	100	42
290770026	1980	2007	0.96	0.004	0.36	98	13
290770026	1980	2007	0.96	0.004	0.36	99	15
290770026	1981	2007	0.98	0.002	0.26	100	32
290770032	1984	2005	0.97	0.002	0.12	100	34
290770032	1985	2005	0.98	0.001	0.21	98	14
290770032	1985	2005	0.98	0.001	0.21	100	17
290770032	1986	2005	0.98	0.001	0.17	100	34
290770032	1984	2006	0.98	0.002	0.16	99	11
290770032	1984	2006	0.98	0.002	0.16	100	7
290770032	1985	2006	0.98	0.002	0.27	95	10
290770032	1985	2006	0.98	0.002	0.27	98	23
290770032	1984	2007	0.97	0.002	0.17	99	14
290770032	1984	2007	0.97	0.002	0.17	100	14
290770032	1985	2007	0.98	0.002	0.28	94	12
290770032	1985	2007	0.98	0.002	0.28	98	14
290770032	1985	2007	0.98	0.002	0.28	99	14
290770032	1986	2007	0.98	0.002	0.23	94	11
290770032	1986	2007	0.98	0.002	0.23	100	12
290770037	1996	2005	0.99	0.001	0.21	100	34
290770037	1997	2005	0.98	0.002	0.42	95	11
290770037	1997	2005	0.98	0.002	0.42	96	13
290770037	1997	2005	0.98	0.002	0.42	98	11
290770037	1997	2005	0.98	0.002	0.42	100	15
290770037	1998	2005	0.99	−0.001	0.86	98	30
290770037	1998	2005	0.99	−0.001	0.86	100	48
290770037	1996	2006	0.98	0.001	0.27	98	13
290770037	1996	2006	0.98	0.001	0.27	99	10
290770037	1996	2006	0.98	0.001	0.27	100	53
290770037	1997	2006	0.96	0.003	0.54	100	32
290770037	1998	2006	0.98	−0.001	1.10	100	43
290770037	1996	2007	0.96	0.000	0.22	99	51
290770037	1996	2007	0.96	0.000	0.22	100	9
290770037	1997	2007	0.97	0.001	0.45	99	69
290770037	1997	2007	0.97	0.001	0.45	100	22
290770037	1998	2007	0.97	−0.002	0.91	99	43
290770037	1998	2007	0.97	−0.002	0.91	100	9
290770040	2002	2005	0.86	0.003	0.82	97	16
290770040	2002	2005	0.86	0.003	0.82	98	15
290770040	2002	2005	0.86	0.003	0.82	99	22
290770040	2002	2005	0.86	0.003	0.82	100	19
290770040	2004	2005	0.99	−0.003	1.58	98	19
290770040	2004	2005	0.99	−0.003	1.58	99	22

Table 2: Listing of Regression Statistics and Significant Outliers for Low to High Year SO_2 Comparisons at Sites within Greene County, MO

Site	High Year	Low Year	R^2	Intercept	Slope	Percentile	Percent of SSE
290770040	2004	2005	0.99	-0.003	1.58	100	5
290770040	2002	2006	0.88	0.003	0.65	99	32
290770040	2002	2006	0.88	0.003	0.65	100	18
290770040	2003	2006	0.99	-0.001	1.25	97	14
290770040	2003	2006	0.99	-0.001	1.25	98	18
290770040	2003	2006	0.99	-0.001	1.25	99	16
290770040	2003	2006	0.99	-0.001	1.25	100	15
290770040	2004	2006	0.99	-0.002	1.25	99	44
290770040	2002	2007	0.94	0.002	0.61	97	12
290770040	2002	2007	0.94	0.002	0.61	99	51
290770040	2002	2007	0.94	0.002	0.61	100	17
290770040	2003	2007	0.95	-0.002	1.12	100	31
290770040	2004	2007	0.96	-0.002	1.12	95	16
290770040	2004	2007	0.96	-0.002	1.12	96	11
290770040	2004	2007	0.96	-0.002	1.12	99	15
290770040	2004	2007	0.96	-0.002	1.12	100	15
290770041	2002	2005	0.90	0.000	1.22	100	54
290770041	2003	2005	0.99	-0.001	1.41	97	16
290770041	2003	2005	0.99	-0.001	1.41	99	37
290770041	2004	2005	0.97	0.000	1.11	99	55
290770041	2004	2005	0.97	0.000	1.11	100	19
290770041	2002	2006	0.75	-0.001	1.07	100	64
290770041	2003	2006	0.96	-0.001	1.33	100	28
290770041	2004	2006	0.98	-0.001	1.07	99	12
290770041	2004	2006	0.98	-0.001	1.07	100	9
290770041	2002	2007	0.96	0.000	0.62	100	32
290770041	2003	2007	0.95	0.000	0.69	98	22
290770041	2003	2007	0.95	0.000	0.69	99	10
290770041	2003	2007	0.95	0.000	0.69	100	29
290770041	2004	2007	0.91	0.001	0.53	98	15
290770041	2004	2007	0.91	0.001	0.53	99	18
290770041	2004	2007	0.91	0.001	0.53	100	28

Table 3: Listing of Regression Statistics and Significant Outliers for Low to High Year SO_2 Comparisons at Sites within Iron County, MO

Site	High Year	Low Year	R^2	Intercept	Slope	Percentile	Percent of SSE
290930030	1997	2001	0.98	−0.002	1.07	99	19
290930030	1997	2001	0.98	−0.002	1.07	100	18
290930030	1998	2001	1.00	−0.002	1.18	99	40
290930030	1999	2001	0.85	0.010	0.79	99	11
290930030	1999	2001	0.85	0.010	0.79	100	39
290930030	1997	2002	0.99	−0.001	0.89	89	11
290930030	1997	2002	0.99	−0.001	0.89	90	11
290930030	1997	2002	0.99	−0.001	0.89	99	44
290930030	1998	2002	0.99	−0.001	0.97	99	27
290930030	1998	2002	0.99	−0.001	0.97	100	48
290930030	1999	2002	0.89	0.009	0.67	98	11
290930030	1999	2002	0.89	0.009	0.67	99	12
290930030	1999	2002	0.89	0.009	0.67	100	37
290930030	1997	2003	0.98	−0.001	0.83	99	42
290930030	1997	2003	0.98	−0.001	0.83	100	24
290930030	1998	2003	0.97	−0.001	0.91	100	66
290930030	1999	2003	0.94	0.006	0.65	99	17
290930030	1999	2003	0.94	0.006	0.65	100	37
290930031	1995	2001	0.95	0.006	0.69	97	11
290930031	1995	2001	0.95	0.006	0.69	98	11
290930031	1995	2001	0.95	0.006	0.69	100	41
290930031	1996	2001	0.99	0.003	0.76	84	11
290930031	1996	2001	0.99	0.003	0.76	85	11
290930031	1996	2001	0.99	0.003	0.76	100	18
290930031	1997	2001	0.99	−0.002	1.08	94	11
290930031	1997	2001	0.99	−0.002	1.08	95	10
290930031	1997	2001	0.99	−0.002	1.08	99	9
290930031	1995	2002	0.95	0.006	0.56	97	13
290930031	1995	2002	0.95	0.006	0.56	98	15
290930031	1995	2002	0.95	0.006	0.56	100	42
290930031	1996	2002	0.99	0.003	0.62	98	11
290930031	1996	2002	0.99	0.003	0.62	99	11
290930031	1996	2002	0.99	0.003	0.62	100	25
290930031	1997	2002	0.99	−0.001	0.88	95	21
290930031	1997	2002	0.99	−0.001	0.88	98	11
290930031	1995	2003	0.92	0.006	0.68	97	13
290930031	1995	2003	0.92	0.006	0.68	99	11
290930031	1995	2003	0.92	0.006	0.68	100	43
290930031	1996	2003	0.98	0.003	0.76	99	23
290930031	1996	2003	0.98	0.003	0.76	100	50
290930031	1997	2003	0.99	−0.003	1.09	100	27

Table 4: Listing of Regression Statistics and Significant Outliers for Low to High Year SO_2 Comparisons at Sites within Cuyahoga County, OH

Site	High Year	Low Year	R^2	Intercept	Slope	Percentile	Percent of SSE
390350045	1985	2005	0.87	−0.008	0.42	100	74
390350045	1986	2005	0.97	−0.006	0.54	99	16
390350045	1986	2005	0.97	−0.006	0.54	100	11
390350045	1987	2005	0.93	−0.006	0.60	100	41
390350045	1985	2006	0.94	−0.008	0.41	100	60
390350045	1986	2006	0.96	−0.005	0.50	97	12
390350045	1986	2006	0.96	−0.005	0.50	98	16
390350045	1986	2006	0.96	−0.005	0.50	99	12
390350045	1987	2006	0.95	−0.005	0.56	98	11
390350045	1987	2006	0.95	−0.005	0.56	100	9
390350045	1985	2007	0.92	−0.010	0.42	100	57
390350045	1986	2007	0.95	−0.006	0.52	98	11
390350045	1986	2007	0.95	−0.006	0.52	99	10
390350045	1987	2007	0.95	−0.007	0.58	100	12
390350060	1993	2005	0.96	0.004	0.47	98	13
390350060	1993	2005	0.96	0.004	0.47	100	46
390350060	1994	2005	0.98	−0.001	0.65	95	12
390350060	1994	2005	0.98	−0.001	0.65	99	20
390350060	1994	2005	0.98	−0.001	0.65	100	24
390350060	1995	2005	0.96	−0.003	0.98	99	20
390350060	1995	2005	0.96	−0.003	0.98	100	41
390350060	1993	2006	0.91	0.004	0.46	100	40
390350060	1994	2006	0.99	−0.002	0.66	99	10
390350060	1995	2006	0.99	−0.004	1.00	100	22
390350060	1993	2007	0.97	0.003	0.57	99	12
390350060	1993	2007	0.97	0.003	0.57	100	27
390350060	1994	2007	0.98	−0.003	0.78	100	57
390350060	1995	2007	0.96	−0.004	1.18	100	77
390350065	1998	2005	0.88	−0.004	1.07	100	67
390350065	1999	2005	0.97	0.003	0.56	99	14
390350065	1999	2005	0.97	0.003	0.56	100	3
390350065	2000	2005	0.91	−0.004	1.33	99	32
390350065	2000	2005	0.91	−0.004	1.33	100	54
390350065	1998	2006	0.98	−0.003	1.34	100	51
390350065	1999	2006	0.89	0.007	0.63	100	22
390350065	2000	2006	0.99	−0.003	1.64	99	28
390350065	2000	2006	0.99	−0.003	1.64	100	13
390350065	1998	2007	0.99	−0.003	1.00	98	15
390350065	1999	2007	0.83	0.005	0.46	100	25
390350065	2000	2007	0.98	−0.003	1.23	96	15
390350065	2000	2007	0.98	−0.003	1.23	97	11
390350065	2000	2007	0.98	−0.003	1.23	98	17
390350065	2000	2007	0.98	−0.003	1.23	100	7

Table 5: Listing of Regression Statistics and Significant Outliers for Low to High Year SO$_2$ Comparisons at Sites within Allegheny County, PA

Site	High Year	Low Year	R^2	Intercept	Slope	Percentile	Percent of SSE
420030002	1981	2005	0.97	−0.001	0.37	100	73
420030002	1982	2005	0.99	0.001	0.35	98	12
420030002	1982	2005	0.99	0.001	0.35	100	9
420030002	1983	2005	1.00	−0.001	0.39	99	18
420030002	1983	2005	1.00	−0.001	0.39	100	10
420030002	1981	2006	0.88	−0.002	0.32	100	78
420030002	1982	2006	0.96	−0.001	0.32	98	13
420030002	1982	2006	0.96	−0.001	0.32	100	60
420030002	1983	2006	0.96	−0.003	0.36	100	62
420030002	1981	2007	0.98	−0.001	0.31	100	58
420030002	1982	2007	0.99	0.001	0.30	99	39
420030002	1983	2007	0.99	−0.001	0.33	99	60
420030002	1983	2007	0.99	−0.001	0.33	100	7
420030010	1998	2005	0.98	0.003	1.26	99	63
420030010	1998	2005	0.98	0.003	1.26	100	12
420030010	1999	2005	0.98	0.003	1.09	99	12
420030010	1999	2005	0.98	0.003	1.09	97	18
420030010	2000	2005	0.98	0.000	0.85	99	67
420030010	1998	2006	0.96	0.001	1.13	99	13
420030010	1998	2006	0.96	0.001	1.13	100	68
420030010	1999	2006	0.95	0.001	0.97	99	18
420030010	1999	2006	0.95	0.001	0.97	100	35
420030010	2000	2006	0.98	−0.002	0.77	99	13
420030010	2000	2006	0.98	−0.002	0.77	100	65
420030010	1998	2007	0.99	0.001	1.13	100	46
420030010	1999	2007	0.93	0.001	0.95	99	47
420030010	2000	2007	0.99	−0.002	0.77	100	20
420030021	1975	2005	0.96	−0.001	0.25	100	56
420030021	1976	2005	0.93	−0.005	0.16	100	57
420030021	1977	2005	0.89	−0.010	0.17	100	45
420030021	1975	2006	1.00	0.001	0.20	99	17
420030021	1976	2006	0.98	−0.003	0.13	99	15
420030021	1976	2006	0.98	−0.003	0.13	100	12
420030021	1975	2007	0.99	0.002	0.19	96	16
420030021	1975	2007	0.99	0.002	0.19	97	21
420030021	1975	2007	0.99	0.002	0.19	100	16
420030021	1976	2007	0.97	−0.001	0.12	99	14
420030021	1976	2007	0.97	−0.001	0.12	100	38
420030021	1977	2007	0.94	−0.005	0.13	100	24
420030064	1976	2005	0.99	0.003	0.20	100	25
420030064	1977	2005	0.96	0.001	0.19	100	20
420030064	1978	2005	0.96	0.003	0.30	100	44
420030064	1976	2006	0.97	−0.001	0.23	100	58
420030064	1977	2006	0.93	−0.004	0.23	100	42
420030064	1978	2006	0.98	−0.002	0.36	95	13
420030064	1978	2006	0.98	−0.002	0.36	96	14
420030064	1978	2006	0.98	−0.002	0.36	97	11
420030064	1978	2006	0.98	−0.002	0.36	100	26
420030064	1976	2007	0.85	−0.007	0.28	99	12
420030064	1976	2007	0.85	−0.007	0.28	100	44

Table 5: Listing of Regression Statistics and Significant Outliers for Low to High Year SO_2 Comparisons at Sites within Allegheny County, PA

Site	High Year	Low Year	R^2	Intercept	Slope	Percentile	Percent of SSE
420030064	1977	2007	0.78	−0.010	0.27	99	12
420030064	1977	2007	0.78	−0.010	0.27	100	41
420030064	1978	2007	0.94	−0.010	0.46	99	19
420030067	1981	2005	0.98	0.002	0.54	100	55
420030067	1982	2005	0.99	0.003	0.55	97	28
420030067	1982	2005	0.99	0.003	0.55	98	27
420030067	1982	2005	0.99	0.003	0.55	100	15
420030067	1983	2005	0.96	0.004	0.54	100	38
420030067	1981	2006	0.99	−0.001	0.50	97	14
420030067	1981	2006	0.99	−0.001	0.50	98	21
420030067	1981	2006	0.99	−0.001	0.50	100	15
420030067	1982	2006	0.98	0.001	0.50	98	18
420030067	1982	2006	0.98	0.001	0.50	100	18
420030067	1983	2006	0.99	0.001	0.50	99	16
420030067	1983	2006	0.99	0.001	0.50	96	18
420030067	1983	2006	0.99	0.001	0.50	100	19
420030067	1981	2007	0.99	0.000	0.49	99	26
420030067	1981	2007	0.99	0.000	0.49	100	13
420030067	1982	2007	0.99	0.001	0.49	91	11
420030067	1982	2007	0.99	0.001	0.49	100	22
420030067	1983	2007	0.98	0.001	0.49	100	14
420030067	1983	2007	0.98	0.001	0.49	98	10

Table 6: Listing of Regression Statistics and Significant Outliers for Low to High Year SO_2 Comparisons at Sites within Beaver County, PA

Site	High Year	Low Year	R^2	Intercept	Slope	Percentile	Percent of SSE
420070002	1983	2005	0.98	0.006	0.51	100	30
420070002	1984	2005	0.96	0.000	0.71	100	70
420070002	1985	2005	0.95	−0.006	0.74	100	63
420070002	1983	2006	0.95	0.006	0.39	100	38
420070002	1984	2006	0.98	0.001	0.55	100	45
420070002	1984	2006	0.98	0.001	0.55	99	10
420070002	1985	2006	0.98	−0.004	0.58	100	63
420070002	1983	2007	0.99	0.002	0.52	98	18
420070002	1983	2007	0.99	0.002	0.52	99	45
420070002	1983	2007	0.99	0.002	0.52	100	9
420070002	1984	2007	0.93	−0.003	0.71	100	71
420070002	1985	2007	0.90	−0.008	0.73	99	11
420070002	1985	2007	0.90	−0.008	0.73	100	59
420070014	1978	2005	0.88	0.003	0.45	100	43
420070014	1978	2006	0.87	0.003	0.37	100	42
420070014	1980	2006	1.00	−0.001	0.48	88	11
420070014	1980	2006	1.00	−0.001	0.48	89	11
420070014	1980	2006	1.00	−0.001	0.48	100	14
420070014	1981	2006	1.00	0.000	0.45	99	13
420070014	1978	2007	0.87	0.005	0.38	100	47
420070014	1980	2007	0.99	0.001	0.49	100	19
420070014	1981	2007	0.99	0.002	0.46	100	13

Table 7: Listing of Regression Statistics and Significant Outliers for Low to High Year SO$_2$ Comparisons at Sites within Jefferson County, TX

Site	High Year	Low Year	R^2	Intercept	Slope	Percentile	Percent of SSE
482450009	1982	2005	0.97	0.000	0.45	99	32
482450009	1983	2005	0.99	0.000	0.52	99	23
482450009	1981	2006	0.77	−0.023	0.77	97	13
482450009	1981	2006	0.77	−0.023	0.77	98	13
482450009	1981	2006	0.77	−0.023	0.77	99	18
482450009	1982	2006	0.93	−0.011	0.85	97	13
482450009	1983	2006	0.89	−0.010	0.97	97	18
482450009	1983	2006	0.89	−0.010	0.97	98	11
482450009	1981	2007	0.75	−0.010	0.34	99	18
482450009	1981	2007	0.75	−0.010	0.34	100	21
482450009	1982	2007	0.86	−0.005	0.36	100	45
482450009	1983	2007	0.86	−0.004	0.42	100	27
482450011	1982	2005	1.00	0.001	0.18	94	11
482450011	1982	2005	1.00	0.001	0.18	100	20
482450011	1983	2005	0.93	0.003	0.21	97	13
482450011	1983	2005	0.93	0.003	0.21	98	13
482450011	1983	2005	0.93	0.003	0.21	100	25
482450011	1984	2005	0.94	0.002	0.13	96	11
482450011	1984	2005	0.94	0.002	0.13	97	14
482450011	1984	2005	0.94	0.002	0.13	99	36
482450011	1982	2006	0.97	−0.002	0.29	100	26
482450011	1982	2006	0.97	−0.002	0.29	99	18
482450011	1983	2006	0.84	0.001	0.32	100	28
482450011	1984	2006	0.89	−0.001	0.21	97	13
482450011	1984	2006	0.89	−0.001	0.21	100	13
482450011	1982	2007	0.98	0.002	0.20	100	53
482450011	1983	2007	0.84	0.004	0.22	97	10
482450011	1983	2007	0.84	0.004	0.22	98	12
482450011	1983	2007	0.84	0.004	0.22	100	29
482450011	1984	2007	0.88	0.002	0.14	97	14
482450011	1984	2007	0.88	0.002	0.14	96	13
482450011	1984	2007	0.88	0.002	0.14	99	10
482450011	1984	2007	0.88	0.002	0.14	95	12
482450011	1984	2007	0.88	0.002	0.14	100	13
482450020	1998	2005	0.98	−0.003	0.48	100	31
482450020	1999	2005	0.98	0.000	0.43	100	26
482450020	1999	2005	0.98	0.000	0.43	98	20
482450020	2000	2005	0.98	−0.003	0.71	100	24
482450020	1998	2006	0.87	−0.010	1.01	100	63
482450020	1999	2006	0.97	−0.005	0.95	99	17
482450020	1999	2006	0.97	−0.005	0.95	100	45
482450020	2000	2006	0.88	−0.010	1.49	100	62
482450020	1998	2007	0.87	−0.005	0.63	100	64
482450020	1999	2007	0.96	−0.002	0.59	99	24
482450020	1999	2007	0.96	−0.002	0.59	100	40
482450020	2000	2007	0.88	−0.005	0.93	100	62
482450020	2000	2007	0.88	−0.005	0.93	99	10