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# Western North Carolina and Surrounding Area Air Quality Annual Trends Supplement

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1987-1999

Ambient Monitoring Section  
Division of Air Quality

*Published November 2000*



North Carolina  
Department of  
Environment  
and  
Natural Resources

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# Western North Carolina and Surrounding Area Air Quality Annual Trends Supplement 1987-1999

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Ambient Monitoring Section Data Analysis Report # 2000.04

## **Acknowledgements**

Public sources of data:

ozone data <[http://www.epa.gov/aqspubl1/annual\\_summary.html](http://www.epa.gov/aqspubl1/annual_summary.html)>

sulfate data <<http://nadp.sws.uiuc.edu/>>

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*Abstract*—This work supplements a comprehensive study of air quality trends in Western NC and adjoining areas of TN and VA published in March, 1999. The N.C. Division of Air Quality statistically tested ambient ozone concentrations and ion concentrations in acid precipitation at monitoring stations in Western NC and Eastern TN beginning in various years (as available) through 1999 for evidence of annual trends. We detected no overall trends in ozone concentrations in the region, although some concentration measures are increasing at four sites. We found decreasing concentrations of the sulfate ion ( $\text{SO}_4^{2-}$ ) in acid precipitation (but no trend in the corresponding deposition rates).

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## I. Introduction

This report is a limited trends analysis for ozone and acid precipitation data in the Western North Carolina region, including some adjoining areas of Tennessee. (A map of this region is shown in Figure 1.) It is a supplement to Cornelius (1999), updating most of its coverage through 1999. Section 2 describes the monitoring sites examined in this study, and Section 3 describes the study methods. We summarize regional ozone trends in Section 4 of this report and regional trends of acid precipitation constituents in Section 5. In Section 6, we also report the individual study sites in detail. We discuss the overall results in Section 7, and we list implications of those findings in Section 8.

The report by Cornelius (1999) had additional analyses of trends for particulate matter data reported earlier for the Southern Appalachian Assessment. This dataset has not been updated and will not be analyzed again here.

Visibility data analyzed by Cornelius (1999) have been withdrawn from public access and so can not be reanalyzed at this time. However, Sisler and Malm (1998) recently “reconstructed” light extinction coefficients from speciated particulate concentration data in the IMPROVE network and offered their own analysis of visibility trends for several Class I federal areas, including the Western North Carolina sites identified in Cornelius (1999).

## 2. Study Sites

We evaluate 6 ozone monitors in North Carolina from Lenoir (Caldwell County) west to the Tennessee border and four Tennessee ozone monitors in Great Smoky Mountains National Park. We also evaluate NADP/NTN acid precipitation data from two of the North Carolina sites, a Tennessee site, and a Virginia site. One of the NC NADP/NTN sites is essentially co-located with an ozone monitor in this study.

We use ozone data from 1987 through 1999 only (some sites are not active for all 14 of these years), and acid precipitation data for 1987 through 1999. For some acid precipitation analyses, we use the entire available series from 1978 through 1999. These are fewer sites than were used in Cornelius (1999), because subsequent judgements made by the custodians of the ozone data have caused some of the monitors to be withdrawn from availability for analysis.

### 3. Methods

Distributions of the first and second maximum one-hour ozone concentrations across the region for each available year are graphed as boxplots and time series. For those boxplots depicting successive year distributions at several sites, a “trend line” calculated using a variable-span smoother function in S-Plus® has been overlaid on the same graph.

The distributions of annual mean concentrations of  $\text{SO}_4^{2-}$  in the region are graphed as boxplots with a “trend line” calculated using a variable-span smoother function in S-Plus®.

In addition to these graphs, we have applied the Mann-Kendall nonparametric trend test to the concentration data. In those cases where we applied a trend test, we also estimated the overall (total) change per year in concentration by fitting a linear least squares regression to the data, and we estimated the average percent change by fitting the same type of regression to the logarithms of the concentrations.

Our individual site analyses (Section 6) contain graphical presentations of time series and trend lines for each pollutant summary available at each site. (This is similar to the regional summaries, except there are no boxplots.) We show the first and second maximum 1-hour averages in one graph and the first and fourth 8-hour ozone averages in another graph.

### 4. Regional Ozone Trends

Table 1 (on four pages) gives a listing of 1-hour ozone maximums for sites and years. In addition to first and second maximum concentrations, it gives two more maximums, effective sample sizes (valid hours) and the number of valid sampling days. Table 2 gives 8-hour ozone maximum statistics in the same format, excluding a column for the number of valid hours of sampling.

Table 3 recapitulates the first maximum 1-hour averages in a two-way layout that allows site values to be compared for the same year. Table 4 treats the second maximum 1-hour averages in the same way. Table 5 gives the first maximum 8-hour averages, and Table 6 gives the *fourth* maximum 8-hour averages in the same two-way layout.

Figure 2 gives annual distributions of first maximum 1-hour ozone concentrations for all sites, as boxplots. A reference line is drawn for the NAAQS that indicates nonattainment if the *second* maximum exceeds it. This variable shows statistical

evidence of a trend ( $P = 0.043$ ). There was an average annual change of 0.0013 ppm (1.24 percent).

In Figure 3, distributions for all (available) years of the first maximum ozone concentrations for each individual location are shown. In Figure 4, distributions for all (available) years of the first maximum ozone concentrations for the selected sites in each state are shown.

Figure 5 gives annual distributions of second maximums for all sites, as boxplots. A reference line is drawn for the NAAQS that indicates nonattainment if the second maximum exceeds it. This variable shows statistical evidence of a trend ( $P = 0.022$ ). There was an average annual change of 0.0012 ppm (1.25 percent).

In Figure 6, distributions of the second maximum ozone concentrations for each individual location are shown for all (available) years. In Figure 7, distributions of the second maximum concentrations for the selected sites in each state are shown for all (available) years.

Figure 8 gives annual distributions of first maximum 8-hour ozone concentrations for all sites, as boxplots. A reference line is drawn for the NAAQS that indicates nonattainment if the *fourth* maximum exceeds it. For this variable we are not able to show statistical evidence of a trend ( $P = 0.10$ ).

In Figure 9, distributions for all (available) years of the first maximums for each individual location are shown. In Figure 10, distributions for all (available) years of the first maximums for the selected sites in each state are shown.

Figure 11 gives annual distributions of fourth maximum 8-hour ozone concentrations for all sites, as boxplots. A reference line is drawn for the NAAQS that indicates nonattainment if the fourth maximum exceeds it. This variable shows statistical evidence of a trend ( $P = 0.017$ ). There was an average annual change of 0.0010 ppm (1.20 percent).

In Figure 12, distributions for all (available) years of the fourth maximums for each individual location are shown. In Figure 13, distributions for all (available) years of the fourth maximums for the selected sites in each state are shown.

## 5. Regional Acid Precipitation Trends

Recently, Seilkop (1992) analyzed trends in precipitation chemistry data from these NADP/NTN monitoring sites for the time period from 1979 through 1990. He found no significant change in precipitation acidity for any of the North Carolina or adjacent South Carolina, Tennessee and Virginia sites. Likewise, Seilkop (1992) found no general evidence of trends in nitrate and ammonium

concentrations, except at one site in the sandhills (Jordan Creek, NC36) and one in the southern coastal region (Clinton, NC35).

For sulfate, Seilkop (1992) did find weak evidence of decreasing concentrations over time at Coweeta (NC25) and at one Piedmont region site (NC34). He stated that the concentration at Coweeta was decreasing about 2 percent per year, but he found that the statistical evidence was inconclusive for this being a real trend, as opposed to random variation. Cornelius (1999) reported highly significant evidence of a trend through 1997 (also finding the rate to average about 2 percent per year, for the 8 years longer duration).

Sulfate ion concentration distributions and trends for 1978 through 1999 are shown as time series graphs in for the four NADP/NTN sites we examined. There was an average annual change of  $-0.028$  mg/l (-1.56 percent), which is very highly significant evidence of a trend ( $P = 0.0001$ ). In Section 6, that trend will be addressed at each separate component site.

In 1999,\* a reviewer for the National Park Service commented to us that nitrate deposition at Elkmont (TN11) appeared to be increasing annually. Cornelius (1999) verified that there was an average annual change of about 0.18 kg/ha nitrate (1.4 percent) through 1997, along with statistically significant evidence of a trend. With the data available through 1999, the apparent annual change now averages 0.15 kg/ha nitrate (1.1 percent), but this can be attributable to random variations rather than a definitive trend, since the statistical test is unable to detect a significant nonzero change ( $P = 0.064$ ). Annual nitrate ion deposition totals for 1981 through 1999 are shown as a time series graph in Figure 15.

## 6. Individual Site Trends

For the 10 monitors updated in this report, we show annual distributions of 1-hour and 8-hour concentrations, beginning with Figure 16 through Figure 38, and we describe the indicated trend for the years that valid data are available. We summarize statistical tests of the ozone trends for 1-hour and 8-hour concentrations in Table 7. The monitors at Lenoir and Look Rock have statistically significant increasing trends for both 1-hour and 8-hour concentrations. The monitor at Clingman's dome has statistically significant increasing trends for 1-hour concentrations but not 8-hour concentrations. At the remaining sites, the evidence of trend is too weak to declare statistically significant.

For the three sulfate monitors in the NADP network with updated date, we show the annual mean sulfate concentrations in Figure 24, Figure 25 and Figure 34, and we describe the indicated trend. In one case (Mt. Mitchell), an ozone and a sulfate monitor are identified as being at the same location. Annual mean sulfate ion concentrations have statistically significant decreasing trends at Coweeta and

Elkmont. At Mt. Mitchell, annual mean sulfate ion concentrations may be increasing; however, the evidence of trend is too weak to declare statistically significant.

### Bryson City

Ozone concentrations for Bryson City from 1995 to 1999 are shown in Figure 16 (1-hour concentrations) and Figure 17 (8-hour concentrations). The maximum 1-hour average is increasing by an average of 0.0048 ppm per year ( $P = 0.05$ ), and the second maximum 1-hour average is increasing by an average of 0.0035 ppm per year ( $P = 0.05$ ). Tests for trend are not statistically significant for the maximum 8-hour concentration ( $P = 0.14$ ) and fourth maximum 8-hour concentration ( $P = 0.14$ ).

### Cades Cove TN

Ozone concentrations for Cades Cove from 1994 to 1999 are shown in Figure 18 (1-hour concentrations) and Figure 19 (8-hour concentrations). Tests for trend are not statistically significant for the maximum 1-hour concentration ( $P = 0.85$ ), second maximum 1-hour concentration ( $P=0.25$ ), maximum 8-hour concentration ( $P = 0.56$ ), and fourth maximum 8-hour concentration ( $P = 0.42$ ).

### Clingmans Dome TN

Ozone concentrations for Clingmans Dome from 1993 to 1999 are shown in Figure 20 (1-hour concentrations) and Figure 21 (8-hour concentrations). The maximum 1-hour average is increasing by an average of 0.0057 ppm per year ( $P = 0.011$ ), and the second maximum 1-hour average is increasing by an average of 0.0053 ppm per year ( $P = 0.015$ ). Tests for trend are not statistically significant for the maximum 8-hour concentration ( $P = 0.23$ ) and fourth maximum 8-hour concentration ( $P = 0.11$ ).

### Cove Mountain TN

Ozone concentrations for Cove Mountain from 1988 to 1999 are shown in Figure 22 (1-hour concentrations) and Figure 23 (8-hour concentrations). Maximum ozone concentrations have been approximately constant. The maximum 1-hour average is increasing by an average of 0.0016 ppm per year ( $P = 0.0048$ ), and the second maximum 1-hour average is increasing by an average of 0.0010 ppm per year ( $P = 0.020$ ). The maximum 8-hour average shows no significant trend ( $P = 0.06$ ), but the fourth maximum 8-hour average has been increasing by an average of 0.0005 ppm per year ( $P = 0.011$ ).

### Coweeta

NADP sulfate concentration distributions for Coweeta from 1978 to 1999 are shown in Figure 24. Sulfate concentrations have decreased by an average of

0.0233 mg/1 per year (about 1.6 percent annual decreases). This trend is highly statistically significant ( $P = 0.0005$ ).

## Elkmont

NADP sulfate concentration distributions for Elkmont from 1980 to 1999 are shown in Figure 25. Sulfate concentrations have decreased by an average of 0.0522 mg/1 per year (about 2.4 percent annual decreases). This trend is highly statistically significant ( $P = 0.0007$ ).

## Fairview and Bent Creek

Ozone concentrations for Fairview from 1987 to 1988 and Bent Creek from 1989 to 1999 are shown in Figure 26 (1-hour concentrations) and Figure 27. Maximum ozone concentrations have been approximately constant, except for slightly higher than average concentrations in 1987, 1988 and 1998. It can not be determined whether the 1987-88 concentrations are higher because of a time trend or because of a difference between the Fairview and Bent Creek sites. Although the higher years are noted, there are no statistically significant trends for maximum 1-hour ozone concentration ( $P = 0.76$ ), second maximum 1-hour concentration ( $P = 0.22$ ), maximum 8-hour concentration ( $P = 0.81$ ) and fourth maximum 8-hour concentration ( $P = 0.30$ ).

## Lenoir

Ozone concentrations for Lenoir from 1989 to 1999 are shown in Figure 28 (1-hour concentrations) and Figure 29 (8-hour concentrations). This site was not monitored in the even numbered years from 1990 through 1996, making the characterization of trends problematic, although trend tests are statistically significant for the maximum 1-hour concentration ( $P = 0.02$ ), second maximum 1-hour concentration ( $P = 0.011$ ), and fourth maximum 8-hour concentration ( $P = 0.009$ ). The trend test significance for the maximum 8-hour concentration is borderline ( $P = 0.051$ ). It seems misleading to suggest average annual increases, because the years prior to 1998 appear to be nearly constant, followed by a marked increase in 1998 to 1999.

## Look Rock TN

Ozone concentrations for Look Rock from 1988 to 1999 are shown in Figure 30 (1-hour concentrations) and Figure 31 (8-hour concentrations). The maximum 1-hour average is increasing by an average of 0.0012 ppm per year ( $P = 0.023$ ), and the second maximum 1-hour average is increasing by an average of 0.0018 ppm per year ( $P = 0.019$ ). The maximum 8-hour average is increasing by an average of 0.0003 ppm per year ( $P = 0.027$ ), and the fourth maximum 8-hour average is increasing by an average of 0.0013 ppm per year ( $P = 0.009$ ).

## Mount Mitchell

Ozone concentrations for Mt. Mitchell from 1995 to 1999 are shown in Figure 32 (1-hour concentrations) and Figure 33 (8-hour concentrations). Tests for trend are not statistically significant for the maximum 1-hour concentration ( $P = 0.90$ ), second maximum 1-hour concentration ( $P=0.53$ ), maximum 8-hour concentration ( $P = 0.80$ ), and fourth maximum 8-hour concentration ( $P = 0.46$ ).

NADP sulfate concentration distributions for Mt. Mitchell from 1985 to 1999 are shown in Figure 34. Sulfate concentrations have **increased** by an average of 0.0224 mg/l per year (about 2.1 percent annually); however, this is not a statistically significant trend ( $P = 0.28$ ).

## Mount Pisgah and Frying Pan Mountain

Ozone concentrations for Mt. Pisgah in 1993 and Frying Pain Mountain from 1994 to 1999 are shown in Figure 35 (1-hour concentrations) and Figure 36 (8-hour concentrations). Tests for trend are not statistically significant for the maximum 1-hour concentration ( $P = 0.07$ ) and second maximum 1-hour concentration ( $P=0.07$ ). The maximum 8-hour average is increasing by an average of 0.0033 ppm per year ( $P = 0.034$ ), and the fourth maximum 8-hour average is increasing by an average of 0.0043 ppm per year ( $P = 0.034$ ).

## Purchase Knob

Ozone concentrations for Purchase Knob from 1995 to 1999 are shown in Figure 37 (1-hour concentrations) and Figure 38 (8-hour concentrations). Tests for trend are not statistically significant for the maximum 1-hour concentration ( $P = 0.62$ ), second maximum 1-hour concentration ( $P=0.62$ ) and maximum 8-hour concentration ( $P = 1$ ). The fourth maximum 8-hour average is increasing by an average of 0.002 ppm per year ( $P = 0.05$ ).

## 7. Discussion

Regional average trends for first and second maximum 1-hour, fourth maximum 8-hour ozone concentrations were statistically significant, although the first maximum 8-hour ozone concentration trend was not statistically significant. For Western NC and the surrounding area there are one or more detectable increasing time trends in the most extreme ozone concentrations at four of 10 sites, and mixed (less definitive) results at the remaining six sites. In 1988 and again in 1998, unusual conditions created exceptionally high ozone concentrations at various sites, confounding the statistical trend tests. (A high concentration leading an increasing trend would tend to mask that trend. A high concentration following a series of unchanging values may result in a spurious significant trend result.)

Except in 1988, 1998 and 1999, there have been no validated violations of the National Ambient Air Quality Standards for ozone (using the 1-hour standard then in effect) in Western NC and the surrounding area. One exceedance (not regarded as a “violation”) occurred at Mount Mitchell in 1995. Unusual meteorological conditions may be responsible for the exceptional concentrations observed in 1988, 1998 and 1999.

Concentrations of the sulfate ion component of acid rain have been decreasing over time at two of the three stations where this has been monitored long enough to statistically detect any trend. At Mt. Mitchell, sulfate concentrations may be increasing, but this remains a statistically inconclusive observation.

## 8. Research and Management Implications

The data analyzed here are of limited value in making decisions about future monitoring or controls seeking to limit ozone production. More detailed analyses are possible, including review of 1-hour or 8-hour concentrations other than the maximums. Statistically modeling the one-hour concentrations as a function of calendar time, altitude, and diurnal variation (and meteorological data, if available) might be useful.

## References

- Cornelius, Wayne L. (1999). Air Quality in Western North Carolina and Surrounding Areas. Ambient Monitoring Section, Division of Air Quality, North Carolina Department of Environment and Natural Resources, Raleigh, NC.
- Seilkop, Steven K. (1992). An Examination of Precipitation Chemistry Data from National Atmospheric Deposition Program Monitoring Sites in North Carolina and Neighboring States: 1979-1990. Analytical Sciences, Inc., Durham, NC.
- Sisler, James F. and William C. Malm (1998). Interpretation of Trends of PM<sub>2.5</sub> and Reconstructed Visibility from the IMPROVE Network.. Submitted to *Journal of the Air and Waste Management Association*.



Table 1. One-hour Ozone Statistics From Western N.C. and Adjoining Great Smoky Mountains National Park Ozone Monitors, 1987-1999.

AIRS	SITE	STATE	year	valid hours	max1h1 (ppm)	max1h2 (ppm)	max1h3 (ppm)	max1h4 (ppm)	valid days	county
370210029	Fairview-Bent Creek	NC	87	4907	0.097	0.086	0.086	0.085	204	BUNCOMBE
370210029	Fairview-Bent Creek	NC	88	2944	0.118	0.110	0.106	0.104	123	BUNCOMBE
370210030	Fairview-Bent Creek	NC	89	5004	0.087	0.079	0.078	0.078	208	BUNCOMBE
370210030	Fairview-Bent Creek	NC	90	4967	0.097	0.091	0.087	0.086	208	BUNCOMBE
370210030	Fairview-Bent Creek	NC	91	5033	0.089	0.079	0.077	0.075	210	BUNCOMBE
370210030	Fairview-Bent Creek	NC	92	5035	0.087	0.083	0.080	0.078	209	BUNCOMBE
370210030	Fairview-Bent Creek	NC	93	4993	0.099	0.079	0.078	0.076	209	BUNCOMBE
370210030	Fairview-Bent Creek	NC	94	5101	0.090	0.084	0.082	0.080	214	BUNCOMBE
370210030	Fairview-Bent Creek	NC	95	5081	0.089	0.085	0.085	0.085	212	BUNCOMBE
370210030	Fairview-Bent Creek	NC	96	4919	0.085	0.084	0.083	0.081	207	BUNCOMBE
370210030	Fairview-Bent Creek	NC	97	5047	0.093	0.090	0.086	0.083	209	BUNCOMBE
370210030	Fairview-Bent Creek	NC	98	5052	0.127	0.114	0.111	0.108	211	BUNCOMBE
370210030	Fairview-Bent Creek	NC	99	5053	0.115	0.099	0.097	0.094	211	BUNCOMBE
370270003	Lenoir	NC	89	4806	0.092	0.090	0.089	0.088	209	CALDWELL
370270003	Lenoir	NC	91	4809	0.096	0.093	0.085	0.084	209	CALDWELL
370270003	Lenoir	NC	93	4769	0.095	0.088	0.087	0.087	206	CALDWELL
370270003	Lenoir	NC	95	4868	0.100	0.095	0.092	0.091	211	CALDWELL
370270003	Lenoir	NC	97	4887	0.099	0.097	0.097	0.091	213	CALDWELL
370270003	Lenoir	NC	98	4835	0.122	0.114	0.111	0.109	211	CALDWELL
370270003	Lenoir	NC	99	4889	0.117	0.115	0.110	0.107	214	CALDWELL

AIRS	SITE	STATE	year	valid hours	max1h1 (ppm)	max1h2 (ppm)	max1h3 (ppm)	max1h4 (ppm)	valid days	county
370870034	Pisgah-Frying Pan Mtn	NC	93	2125	0.092	0.087	0.082	0.076	90	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	94	2746	0.078	0.077	0.075	0.074	115	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	95	4703	0.101	0.095	0.094	0.092	192	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	96	4572	0.101	0.095	0.095	0.094	189	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	97	4692	0.094	0.089	0.089	0.086	194	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	98	4265	0.116	0.109	0.107	0.106	176	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	99	5079	0.110	0.107	0.104	0.104	211	HAYWOOD
370870036	Purchase Knob	NC	95	3122	0.107	0.107	0.101	0.094	133	HAYWOOD
370870036	Purchase Knob	NC	96	4054	0.092	0.092	0.090	0.090	171	HAYWOOD
370870036	Purchase Knob	NC	97	4829	0.109	0.106	0.103	0.097	211	HAYWOOD
370870036	Purchase Knob	NC	98	4890	0.115	0.100	0.099	0.097	204	HAYWOOD
370870036	Purchase Knob	NC	99	5113	0.105	0.103	0.102	0.099	214	HAYWOOD
371730002	Bryson City	NC	95	4650	0.081	0.077	0.076	0.075	201	SWAIN
371730002	Bryson City	NC	96	3943	0.076	0.075	0.072	0.070	172	SWAIN
371730002	Bryson City	NC	97	4761	0.086	0.081	0.078	0.077	209	SWAIN
371730002	Bryson City	NC	98	4763	0.092	0.090	0.087	0.087	209	SWAIN
371730002	Bryson City	NC	99	4755	0.100	0.091	0.086	0.084	208	SWAIN
371990003	Mt. Mitchell	NC	92	3971	0.096	0.090	0.088	0.088	168	YANCEY
371990003	Mt. Mitchell	NC	93	3641	0.102	0.097	0.096	0.093	158	YANCEY
371990003	Mt. Mitchell	NC	94	3899	0.093	0.092	0.090	0.089	167	YANCEY
371990003	Mt. Mitchell	NC	95	3913	0.127	0.111	0.108	0.103	170	YANCEY
371990003	Mt. Mitchell	NC	96	2933	0.094	0.090	0.086	0.085	126	YANCEY
371990003	Mt. Mitchell	NC	97	4879	0.085	0.085	0.084	0.083	212	YANCEY

AIRS	SITE	STATE	year	valid hours	max1h1 (ppm)	max1h2 (ppm)	max1h3 (ppm)	max1h4 (ppm)	valid days	county
371990003	Mt. Mitchell	NC	98	1724	0.096	0.083	0.074	0.073	73	YANCEY
371990003	Mt. Mitchell	NC	99	4063	0.109	0.104	0.101	0.097	178	YANCEY
470090101	Look Rock TN	TN	88	1879	0.112	0.103	0.093	0.089	87	BLOUNT
470090101	Look Rock TN	TN	89	4764	0.098	0.097	0.093	0.089	205	BLOUNT
470090101	Look Rock TN	TN	90	4353	0.108	0.107	0.106	0.097	174	BLOUNT
470090101	Look Rock TN	TN	91	4504	0.097	0.096	0.091	0.089	190	BLOUNT
470090101	Look Rock TN	TN	92	4690	0.098	0.096	0.095	0.094	203	BLOUNT
470090101	Look Rock TN	TN	93	4423	0.107	0.104	0.101	0.093	185	BLOUNT
470090101	Look Rock TN	TN	94	4562	0.116	0.106	0.106	0.104	194	BLOUNT
470090101	Look Rock TN	TN	95	3446	0.123	0.120	0.116	0.107	147	BLOUNT
470090101	Look Rock TN	TN	96	4650	0.106	0.102	0.100	0.100	202	BLOUNT
470090101	Look Rock TN	TN	97	4594	0.117	0.115	0.115	0.110	194	BLOUNT
470090101	Look Rock TN	TN	98	5772	0.135	0.120	0.119	0.118	242	BLOUNT
470090101	Look Rock TN	TN	99	5809	0.125	0.123	0.117	0.117	244	BLOUNT
470090102	Cades Cove TN	TN	94	3988	0.111	0.100	0.098	0.092	172	BLOUNT
470090102	Cades Cove TN	TN	95	4785	0.107	0.101	0.097	0.097	208	BLOUNT
470090102	Cades Cove TN	TN	96	4805	0.093	0.093	.	0.087	211	BLOUNT
470090102	Cades Cove TN	TN	97	5015	0.102	0.099	0.099	0.095	213	BLOUNT
470090102	Cades Cove TN	TN	98	5016	0.106	0.101	0.100	0.097	211	BLOUNT
470090102	Cades Cove TN	TN	99	4323	0.116	0.102	0.101	0.100	181	BLOUNT
471550101	Cove Mtn TN	TN	88	1353	0.109	0.103	0.097	0.095	58	SEVIER
471550101	Cove Mtn TN	TN	89	2949	0.093	0.088	0.087	0.085	122	SEVIER
471550101	Cove Mtn TN	TN	90	3214	0.102	0.101	0.098	0.091	139	SEVIER

AIRS	SITE	STATE	year	valid hours	max1h1 (ppm)	max1h2 (ppm)	max1h3 (ppm)	max1h4 (ppm)	valid days	county
471550101	Cove Mtn TN	TN	91	4395	0.101	0.098	0.093	0.092	187	SEVIER
471550101	Cove Mtn TN	TN	92	2674	0.089	0.083	0.081	0.080	115	SEVIER
471550101	Cove Mtn TN	TN	93	4594	0.113	0.099	0.099	0.098	193	SEVIER
471550101	Cove Mtn TN	TN	94	4792	0.120	0.110	0.106	0.101	208	SEVIER
471550101	Cove Mtn TN	TN	95	4596	0.118	0.111	0.109	0.104	199	SEVIER
471550101	Cove Mtn TN	TN	96	4879	0.111	0.107	0.100	0.100	205	SEVIER
471550101	Cove Mtn TN	TN	97	4839	0.120	0.106	0.105	0.105	203	SEVIER
471550101	Cove Mtn TN	TN	98	5515	0.124	0.120	0.119	0.115	231	SEVIER
471550101	Cove Mtn TN	TN	99	5493	0.127	0.114	0.113	0.112	231	SEVIER
471550102	Clingmans Dome TN	TN	93	4087	0.082	0.081	0.080	0.079	173	SEVIER
471550102	Clingmans Dome TN	TN	94	4085	0.102	0.102	0.101	0.097	177	SEVIER
471550102	Clingmans Dome TN	TN	95	4447	0.107	0.105	0.100	0.097	194	SEVIER
471550102	Clingmans Dome TN	TN	96	4104	0.106	0.102	0.095	0.095	178	SEVIER
471550102	Clingmans Dome TN	TN	97	4542	0.111	0.110	0.109	0.099	189	SEVIER
471550102	Clingmans Dome TN	TN	98	4291	0.119	0.116	0.115	0.114	180	SEVIER
471550102	Clingmans Dome TN	TN	99	4337	0.116	0.113	0.109	0.107	177	SEVIER

Table 2. Eight-hour Ozone Statistics From Western N.C. and Adjoining Great Smoky Mountains National Park Ozone Monitors, 1987-1999.

AIRS	SITE	STATE	year	max8h1 (ppm)	max8h2 (ppm)	max8h3 (ppm)	max8h4 (ppm)	valid days	county
370210029	Fairview-Bent Creek	NC	87	0.090	0.081	0.077	0.076	204	BUNCOMBE
370210029	Fairview-Bent Creek	NC	88	0.103	0.097	0.093	0.093	123	BUNCOMBE
370210030	Fairview-Bent Creek	NC	89	0.083	0.080	0.075	0.072	207	BUNCOMBE
370210030	Fairview-Bent Creek	NC	90	0.081	0.077	0.076	0.073	207	BUNCOMBE
370210030	Fairview-Bent Creek	NC	91	0.068	0.065	0.064	0.063	211	BUNCOMBE
370210030	Fairview-Bent Creek	NC	92	0.071	0.065	0.065	0.064	211	BUNCOMBE
370210030	Fairview-Bent Creek	NC	93	0.073	0.067	0.066	0.066	212	BUNCOMBE
370210030	Fairview-Bent Creek	NC	94	0.079	0.075	0.071	0.069	214	BUNCOMBE
370210030	Fairview-Bent Creek	NC	95	0.078	0.077	0.076	0.076	214	BUNCOMBE
370210030	Fairview-Bent Creek	NC	96	0.078	0.077	0.076	0.076	210	BUNCOMBE
370210030	Fairview-Bent Creek	NC	97	0.078	0.078	0.076	0.075	210	BUNCOMBE
370210030	Fairview-Bent Creek	NC	98	0.103	0.098	0.095	0.090	213	BUNCOMBE
370210030	Fairview-Bent Creek	NC	99	0.089	0.085	0.084	0.084	210	BUNCOMBE
370270003	Lenoir	NC	89	0.081	0.079	0.077	0.075	210	CALDWELL
370270003	Lenoir	NC	91	0.091	0.079	0.076	0.075	213	CALDWELL
370270003	Lenoir	NC	93	0.082	0.079	0.077	0.076	212	CALDWELL
370270003	Lenoir	NC	95	0.092	0.083	0.080	0.079	214	CALDWELL
370270003	Lenoir	NC	97	0.085	0.084	0.082	0.079	214	CALDWELL
370270003	Lenoir	NC	98	0.109	0.101	0.101	0.098	212	CALDWELL
370270003	Lenoir	NC	99	0.103	0.097	0.096	0.094	214	CALDWELL

AIRS	SITE	STATE	year	max8h1 (ppm)	max8h2 (ppm)	max8h3 (ppm)	max8h4 (ppm)	valid days	county
370870034	Pisgah-Frying Pan Mtn	NC	93	0.078	0.078	0.071	0.070	90	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	94	0.071	0.069	0.067	0.066	116	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	95	0.087	0.087	0.086	0.085	116	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	96	0.093	0.092	0.088	0.088	197	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	97	0.087	0.087	0.085	0.085	195	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	98	0.108	0.106	0.104	0.102	178	HAYWOOD
370870035	Pisgah-Frying Pan Mtn	NC	99	0.098	0.098	0.097	0.096	211	HAYWOOD
370870036	Purchase Knob	NC	95	0.103	0.095	0.092	0.085	139	HAYWOOD
370870036	Purchase Knob	NC	96	0.088	0.083	0.082	0.079	184	HAYWOOD
370870036	Purchase Knob	NC	97	0.094	0.093	0.089	0.087	213	HAYWOOD
370870036	Purchase Knob	NC	98	0.102	0.098	0.093	0.092	205	HAYWOOD
370870036	Purchase Knob	NC	99	0.100	0.097	0.096	0.093	214	HAYWOOD
371730002	Bryson City	NC	95	0.070	0.069	0.068	0.067	205	SWAIN
371730002	Bryson City	NC	96	0.065	0.065	0.065	0.063	175	SWAIN
371730002	Bryson City	NC	97	0.079	0.071	0.071	0.070	208	SWAIN
371730002	Bryson City	NC	98	0.086	0.083	0.080	0.078	208	SWAIN
371730002	Bryson City	NC	99	0.082	0.077	0.077	0.076	206	SWAIN
371990003	Mt. Mitchell	NC	92	0.086	0.085	0.085	0.085	172	YANCEY
371990003	Mt. Mitchell	NC	93	0.092	0.090	0.086	0.086	160	YANCEY
371990003	Mt. Mitchell	NC	94	0.090	0.088	0.079	0.079	175	YANCEY
371990003	Mt. Mitchell	NC	95	0.105	0.098	0.092	0.090	174	YANCEY
371990003	Mt. Mitchell	NC	96	0.083	0.082	0.080	0.078	133	YANCEY
371990003	Mt. Mitchell	NC	97	0.081	0.078	0.076	0.075	214	YANCEY

AIRS	SITE	STATE	year	max8h1 (ppm)	max8h2 (ppm)	max8h3 (ppm)	max8h4 (ppm)	valid days	county
371990003	Mt. Mitchell	NC	98	0.084	0.070	0.069	0.069	71	YANCEY
371990003	Mt. Mitchell	NC	99	0.099	0.098	0.094	0.094	172	YANCEY
470090101	Look Rock TN	TN	88	0.107	0.098	0.090	0.078	76	BLOUNT
470090101	Look Rock TN	TN	89	0.088	0.086	0.086	0.086	206	BLOUNT
470090101	Look Rock TN	TN	90	0.096	0.094	0.093	0.092	175	BLOUNT
470090101	Look Rock TN	TN	91	0.086	0.086	0.081	0.081	192	BLOUNT
470090101	Look Rock TN	TN	92	0.094	0.094	0.091	0.088	202	BLOUNT
470090101	Look Rock TN	TN	93	0.100	0.097	0.094	0.091	187	BLOUNT
470090101	Look Rock TN	TN	94	0.109	0.102	0.096	0.093	193	BLOUNT
470090101	Look Rock TN	TN	95	0.109	0.103	0.102	0.101	146	BLOUNT
470090101	Look Rock TN	TN	96	0.090	0.089	0.089	0.088	199	BLOUNT
470090101	Look Rock TN	TN	97	0.111	0.108	0.100	0.098	187	BLOUNT
470090101	Look Rock TN	TN	98	0.122	0.116	0.112	0.110	212	BLOUNT
470090101	Look Rock TN	TN	99	0.110	0.102	0.099	0.092	121	BLOUNT
470090102	Cades Cove TN	TN	94	0.083	0.083	0.081	0.077	205	BLOUNT
470090102	Cades Cove TN	TN	95	0.084	0.082	0.078	0.076	211	BLOUNT
470090102	Cades Cove TN	TN	96	0.079	0.076	0.076	0.075	122	BLOUNT
470090102	Cades Cove TN	TN	97	0.084	0.079	0.079	0.077	211	BLOUNT
470090102	Cades Cove TN	TN	98	0.090	0.088	0.086	0.086	208	BLOUNT
470090102	Cades Cove TN	TN	99	0.083	0.081	0.079	0.077	87	BLOUNT
471550101	Cove Mtn TN	TN	88	0.100	0.099	0.092	0.088	56	SEVIER
471550101	Cove Mtn TN	TN	89	0.084	0.082	0.081	0.081	113	SEVIER
471550101	Cove Mtn TN	TN	90	0.094	0.094	0.087	0.087	130	SEVIER

AIRS	SITE	STATE	year	max8h1 (ppm)	max8h2 (ppm)	max8h3 (ppm)	max8h4 (ppm)	valid days	county
471550101	Cove Mtn TN	TN	91	0.086	0.086	0.083	0.082	186	SEVIER
471550101	Cove Mtn TN	TN	92	0.079	0.078	0.077	0.075	115	SEVIER
471550101	Cove Mtn TN	TN	93	0.100	0.099	0.091	0.091	194	SEVIER
471550101	Cove Mtn TN	TN	94	0.111	0.108	0.097	0.088	206	SEVIER
471550101	Cove Mtn TN	TN	95	0.108	0.103	0.100	0.097	200	SEVIER
471550101	Cove Mtn TN	TN	96	0.094	0.093	0.092	0.092	199	SEVIER
471550101	Cove Mtn TN	TN	97	0.104	0.097	0.095	0.095	193	SEVIER
471550101	Cove Mtn TN	TN	98	0.111	0.110	0.107	0.106	197	SEVIER
471550101	Cove Mtn TN	TN	99	0.105	0.096	0.094	0.094	96	SEVIER
471550102	Clingmans Dome TN	TN	93	NA	NA	NA	NA	NA	SEVIER
471550102	Clingmans Dome TN	TN	94	0.097	0.097	0.090	0.076	179	SEVIER
471550102	Clingmans Dome TN	TN	95	0.097	0.095	0.089	0.089	191	SEVIER
471550102	Clingmans Dome TN	TN	96	0.094	0.089	0.089	0.088	177	SEVIER
471550102	Clingmans Dome TN	TN	97	0.097	0.096	0.090	0.089	181	SEVIER
471550102	Clingmans Dome TN	TN	98	0.113	0.112	0.106	0.106	179	SEVIER
471550102	Clingmans Dome TN	TN	99	0.105	0.104	0.091	0.089	91	SEVIER



Table 3. First Maximum 1-Hour Ozone Concentrations (ppm) in Western N.C.: 1987-1999.

year	Bryson City	Cades Cove TN	Clingmans Dome TN	Cove Mtn TN	Fairview -Bent Creek	Lenoir	Look Rock TN	Mt. Mitchell	Pisgah-Frying Pan Mtn	Purchase Knob
1987	NA	NA	NA	NA	0.097	NA	NA	NA	NA	NA
1988	NA	NA	NA	0.109	0.118	NA	0.112	NA	NA	NA
1989	NA	NA	NA	0.093	0.087	0.092	0.098	NA	NA	NA
1990	NA	NA	NA	0.102	0.097	NA	0.108	NA	NA	NA
1991	NA	NA	NA	0.101	0.089	0.096	0.097	NA	NA	NA
1992	NA	NA	NA	0.089	0.087	NA	0.098	0.096	NA	NA
1993	NA	NA	0.082	0.113	0.099	0.095	0.107	0.102	0.092	NA
1994	NA	0.111	0.102	0.120	0.090	NA	0.116	0.093	0.078	NA
1995	0.081	0.107	0.107	0.118	0.089	0.100	0.123	0.127	0.101	0.107
1996	0.076	0.093	0.106	0.111	0.085	NA	0.106	0.094	0.101	0.092
1997	0.086	0.102	0.111	0.120	0.093	0.099	0.117	0.085	0.094	0.109
1998	0.092	0.106	0.119	0.124	0.127	0.122	0.135	0.096	0.116	0.115
1999	0.100	0.116	0.116	0.127	0.115	0.117	0.125	0.109	0.110	0.105

Table 4. Second Maximum 1-Hour Ozone Concentrations (ppm) in Western N.C.: 1987-1999.

year	Bryson City	Cades Cove TN	Clingmans Dome TN	Cove Mtn TN	Fairview -Bent Creek	Lenoir	Look Rock TN	Mt. Mitchell	Pisgah-Frying Pan Mtn	Purchase Knob
1987	NA	NA	NA	NA	0.086	NA	NA	NA	NA	NA
1988	NA	NA	NA	0.103	0.110	NA	0.103	NA	NA	NA
1989	NA	NA	NA	0.088	0.079	0.090	0.097	NA	NA	NA
1990	NA	NA	NA	0.101	0.091	NA	0.107	NA	NA	NA
1991	NA	NA	NA	0.098	0.079	0.093	0.096	NA	NA	NA
1992	NA	NA	NA	0.083	0.083	NA	0.096	0.090	NA	NA
1993	NA	NA	0.081	0.099	0.079	0.088	0.104	0.097	0.087	NA
1994	NA	0.100	0.102	0.110	0.084	NA	0.106	0.092	0.077	NA
1995	0.077	0.101	0.105	0.111	0.085	0.095	0.120	0.111	0.095	0.107
1996	0.075	0.093	0.102	0.107	0.084	NA	0.102	0.090	0.095	0.092
1997	0.081	0.099	0.110	0.106	0.090	0.097	0.115	0.085	0.089	0.106
1998	0.090	0.101	0.116	0.120	0.114	0.114	0.120	0.083	0.109	0.100
1999	0.091	0.102	0.113	0.114	0.099	0.115	0.123	0.104	0.107	0.103

Table 5. First Maximum 8-Hour Ozone Concentrations (ppm) in Western N.C.: 1987-1999.

year	Bryson City	Cades Cove TN	Clingmans Dome TN	Cove Mtn TN	Fairview -Bent Creek	Lenoir	Look Rock TN	Mt. Mitchell	Pisgah-Frying Pan Mtn	Purchase Knob
1987	NA	NA	NA	NA	0.090	NA	NA	NA	NA	NA
1988	NA	NA	NA	0.100	0.103	NA	0.107	NA	NA	NA
1989	NA	NA	NA	0.084	0.083	0.081	0.088	NA	NA	NA
1990	NA	NA	NA	0.094	0.081	NA	0.096	NA	NA	NA
1991	NA	NA	NA	0.086	0.068	0.091	0.086	NA	NA	NA
1992	NA	NA	NA	0.079	0.071	NA	0.094	0.086	NA	NA
1993	NA	NA	NA	0.100	0.073	0.082	0.100	0.092	0.078	NA
1994	NA	0.083	0.097	0.111	0.079	NA	0.109	0.090	0.071	NA
1995	0.070	0.084	0.097	0.108	0.078	0.092	0.109	0.105	0.087	0.103
1996	0.065	0.079	0.094	0.094	0.078	NA	0.090	0.083	0.093	0.088
1997	0.079	0.084	0.097	0.104	0.078	0.085	0.111	0.081	0.087	0.094
1998	0.086	0.090	0.113	0.111	0.103	0.109	0.122	0.084	0.108	0.102
1999	0.082	0.083	0.105	0.105	0.089	0.103	0.110	0.099	0.098	0.100

Table 6. Fourth Maximum 8-Hour Ozone Concentrations (ppm) in Western N.C.: 1987-1999.

year	Bryson City	Cades Cove TN	Clingmans Dome TN	Cove Mtn TN	Fairview -Bent Creek	Lenoir	Look Rock TN	Mt. Mitchell	Pisgah-Frying Pan Mtn	Purchase Knob
1987	NA	NA	NA	NA	0.076	NA	NA	NA	NA	NA
1988	NA	NA	NA	0.088	0.093	NA	0.078	NA	NA	NA
1989	NA	NA	NA	0.081	0.072	0.075	0.086	NA	NA	NA
1990	NA	NA	NA	0.087	0.073	NA	0.092	NA	NA	NA
1991	NA	NA	NA	0.082	0.063	0.075	0.081	NA	NA	NA
1992	NA	NA	NA	0.075	0.064	NA	0.088	0.085	NA	NA
1993	NA	NA	NA	0.091	0.066	0.076	0.091	0.086	0.070	NA
1994	NA	0.077	0.076	0.088	0.069	NA	0.093	0.079	0.066	NA
1995	0.067	0.076	0.089	0.097	0.076	0.079	0.101	0.090	0.085	0.085
1996	0.063	0.075	0.088	0.092	0.076	NA	0.088	0.078	0.088	0.079
1997	0.070	0.077	0.089	0.095	0.075	0.079	0.098	0.075	0.085	0.087
1998	0.078	0.086	0.106	0.106	0.090	0.098	0.110	0.069	0.102	0.092
1999	0.076	0.077	0.089	0.094	0.084	0.094	0.092	0.094	0.096	0.093

Table 7. Statistical Tests for Trend at the Ozone Monitoring Sites: 1987-99.

SITE	max1h1		max1h2		max8h1		max8h4	
	Annual change (ppm)	p-value	Annual change (ppm)	p-value	Annual change (ppm)	p-value	Annual change (ppm)	p-value
Bryson City	0.00475	0.0500	0.00350	0.0500	0.00300	0.1420	0.00225	0.1420
Cades Cove TN	0.00100	0.8510	0.00040	0.2510	0.00000	0.5590	0.00000	0.4210
Clingmans Dome TN	<b>0.00567</b>	<b>0.0107</b>	0.00533	0.0151	0.00160	0.2270	0.00260	0.1070
Cove Mtn TN	<b>0.00164</b>	<b>0.0048</b>	0.00100	0.0197	0.00046	0.0622	<b>0.00055</b>	<b>0.0110</b>
Fairview/Bent Creek	0.00150	0.7590	0.00108	0.2180	-0.00008	0.8060	0.00067	0.2960
Lenoir	0.00250	0.0243	<b>0.00250</b>	<b>0.0107</b>	0.00220	0.0509	<b>0.00190</b>	<b>0.0090</b>
Look Rock TN	0.00118	0.0233	0.00182	0.0192	0.00027	0.0233	<b>0.00127</b>	<b>0.0088</b>
Mt. Mitchell	0.00186	0.9010	0.00200	0.5330	0.00186	0.8050	0.00129	0.4580
Pisg/Frying Pan Mtn	0.00300	0.0683	0.00333	0.0683	0.00333	0.0334	0.00433	0.0334
Purchase Knob	-0.00050	0.6240	-0.00100	0.6240	-0.00075	1.0000	0.00200	0.0500

Trends with a p-value less than 0.0125 are declared significantly different from zero. These p-values and associated annual changes are typeset in boldface.



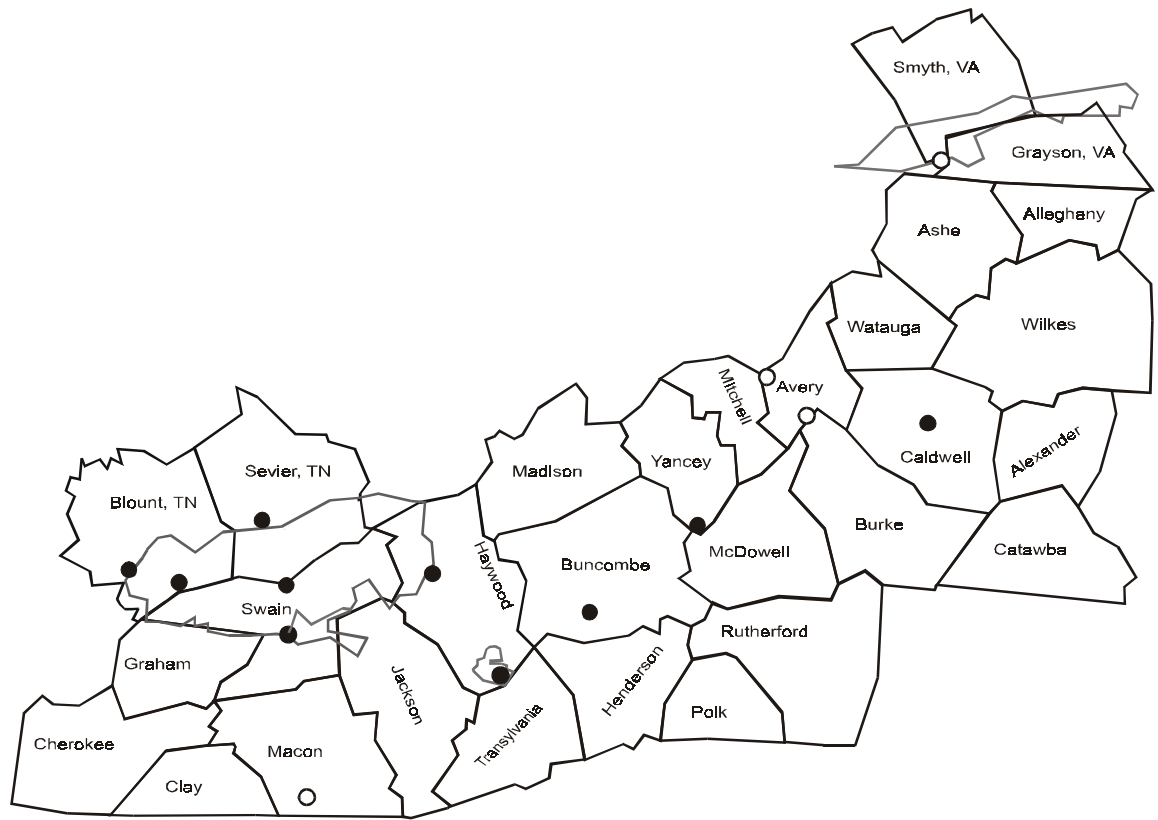


Figure 1. Western NC Study Region, Including Adjoining Area of TN, With Ozone Monitor Locations and Boundaries of the Great Smoky Mountains National Park and Shining Rock Wilderness Area. Monitors shown with open circles were analyzed in Cornelius (1999) and subsequently discontinued or made unavailable.

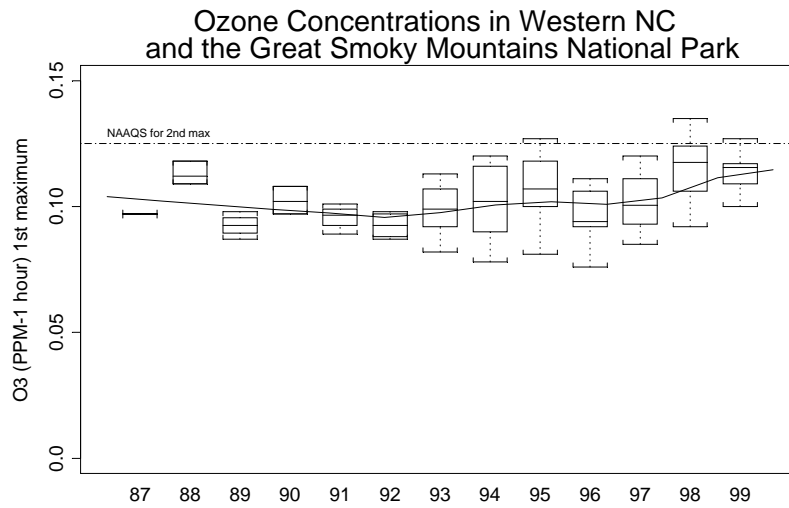


Figure 2. Annual Maximum 1-Hour Ozone Concentrations: 10 Locations Represented By 12 Sites

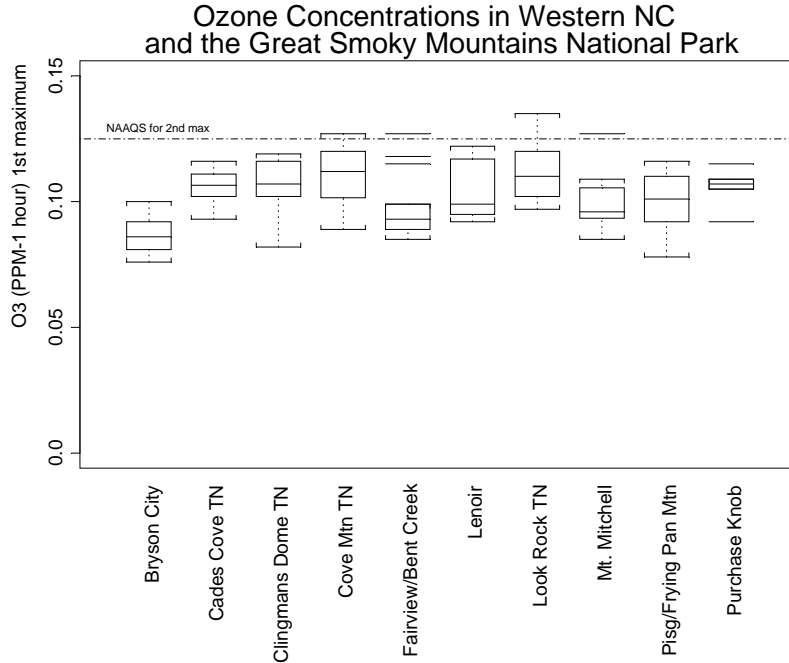


Figure 3. Annual Maximum 1-Hour Ozone Concentrations: Each Location, All Years

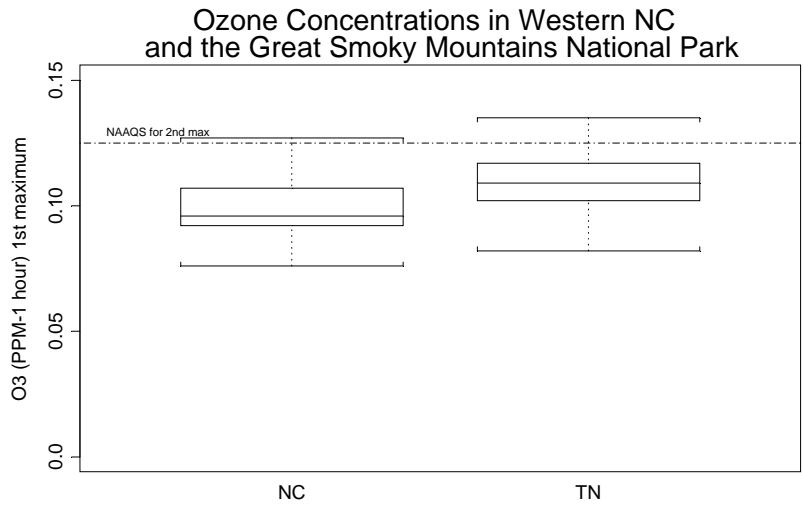


Figure 4. Maximum 1-Hour Ozone Concentrations by State, for All Years

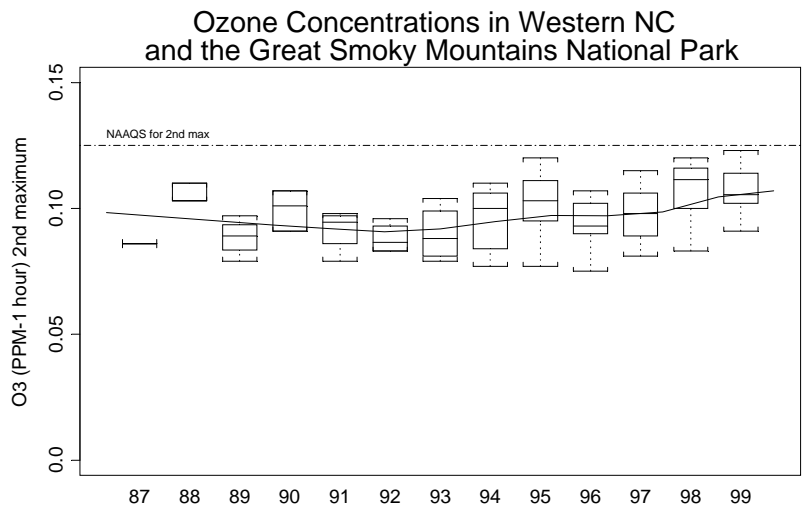


Figure 5. Annual Second Maximum 1-Hour Ozone Concentrations: 10 Locations Represented by 12 Sites

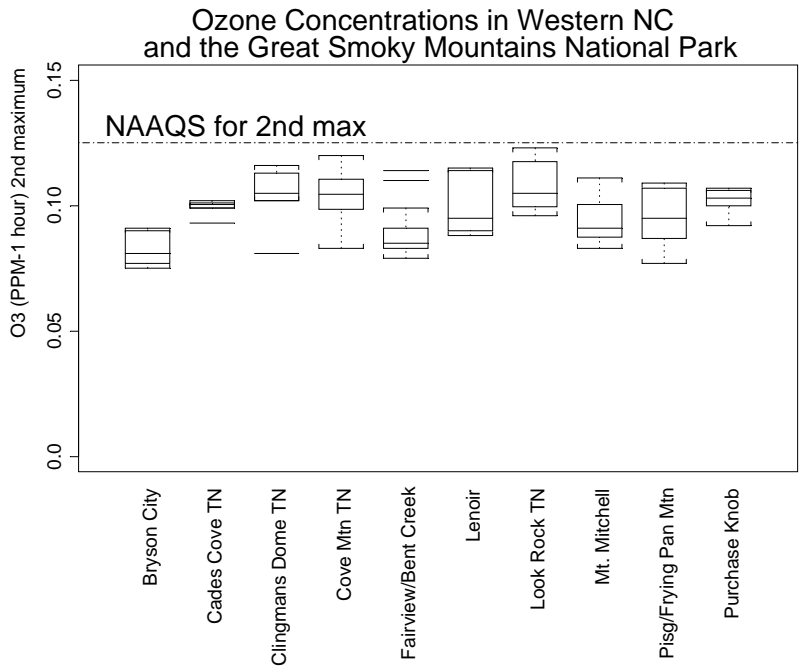


Figure 6. Second Maximum 1-Hour Ozone Concentrations: Each Location, All Years

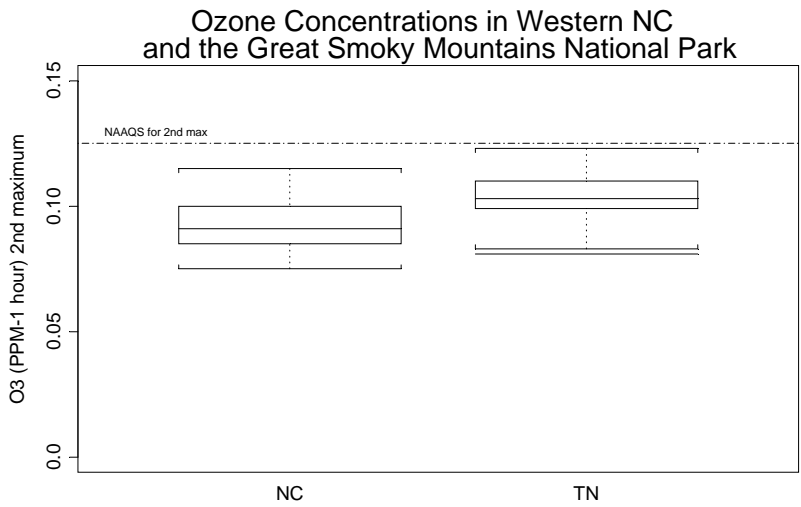


Figure 7. Second Maximum 1-Hour Ozone Concentrations: Grouped by State, All Years



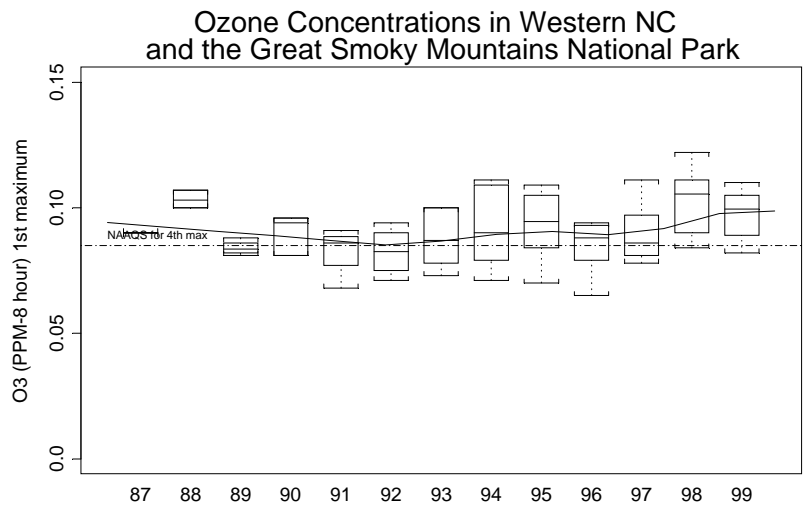


Figure 8. Annual Maximum 8-Hour Ozone Concentrations: 10 Locations Represented by 12 Sites

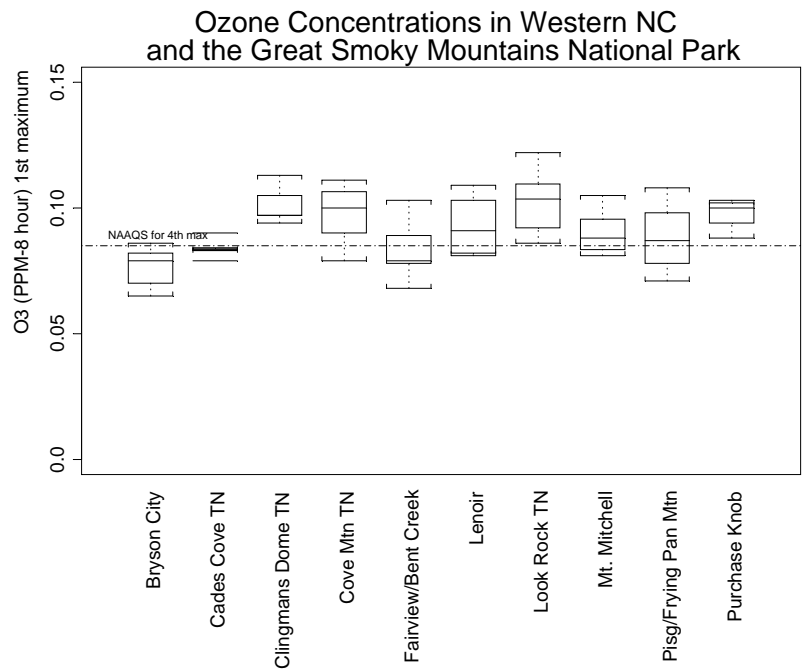


Figure 9. Maximum 8-Hour Ozone Concentrations, At Each Location, For All Years

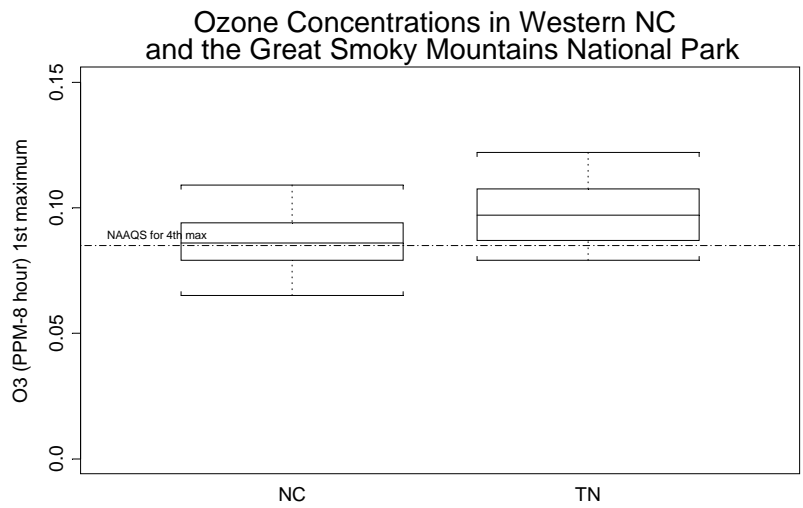


Figure 10. Maximum 8-Hour Ozone Concentrations, By State, For All Years

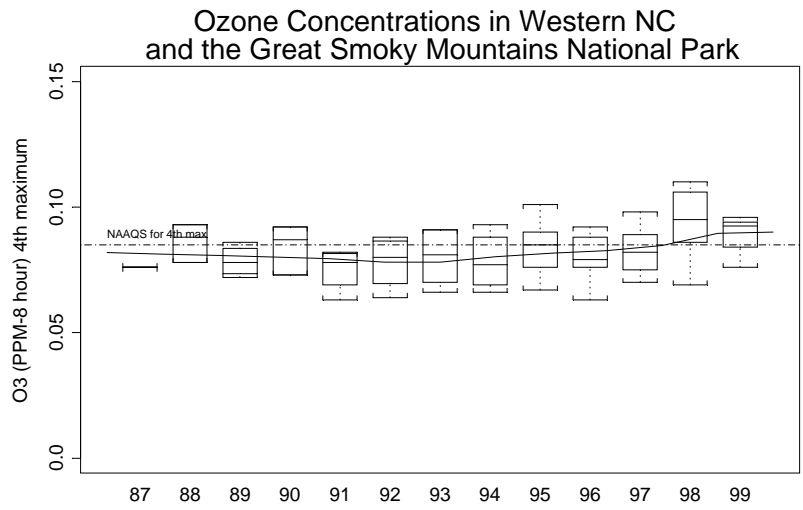


Figure 11. Annual Fourth Maximum 8-Hour Ozone Concentrations: 10 Locations Represented by 12 Sites

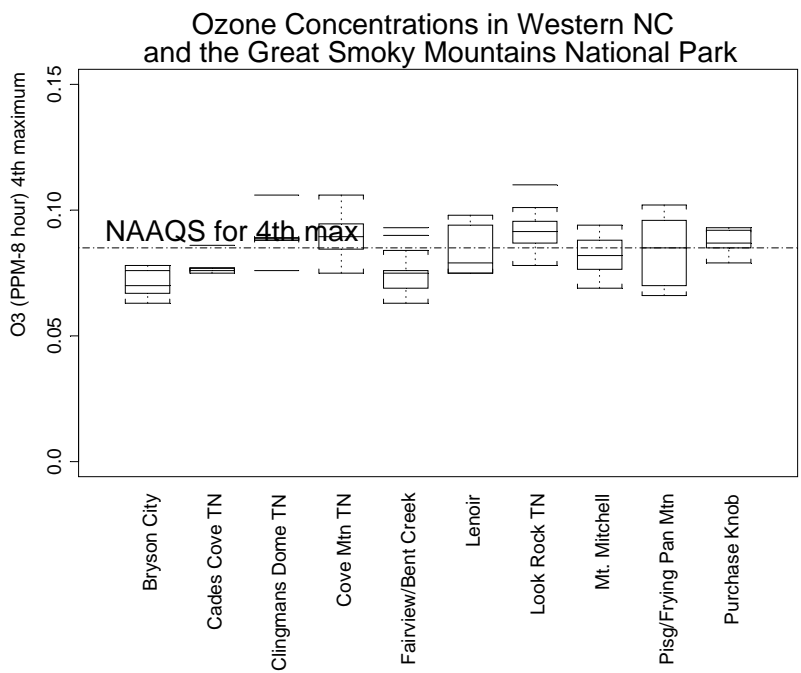


Figure 12. Fourth Maximum 8-Hour Ozone Concentrations, For Each Location, All Years

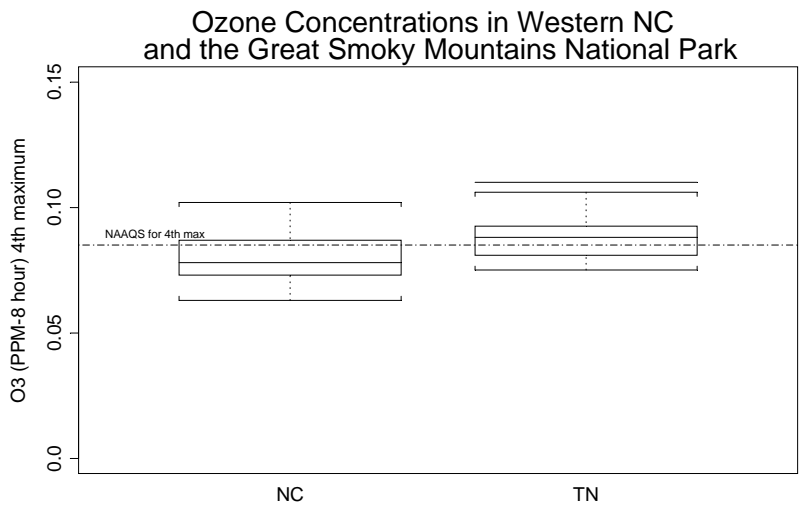


Figure 13. Fourth Maximum 8-Hour Ozone Concentrations, By State, All Years

### GSMN Park Annual Average Sulfate Concentration

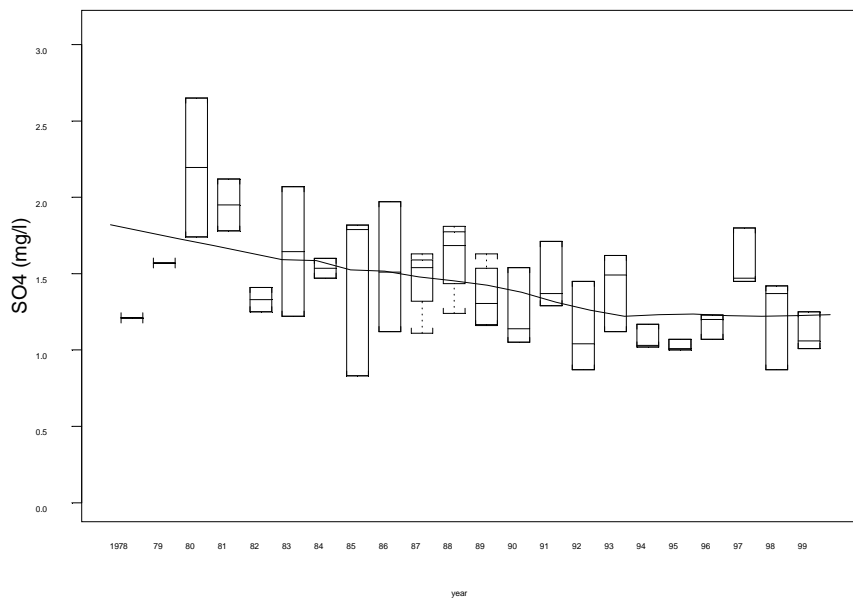


Figure 14. Sulfate Ion Concentration Distributions in Western North Carolina and Surrounding Area (Four NADP Locations).

### GSMN Park Annual Total Nitrate Deposition

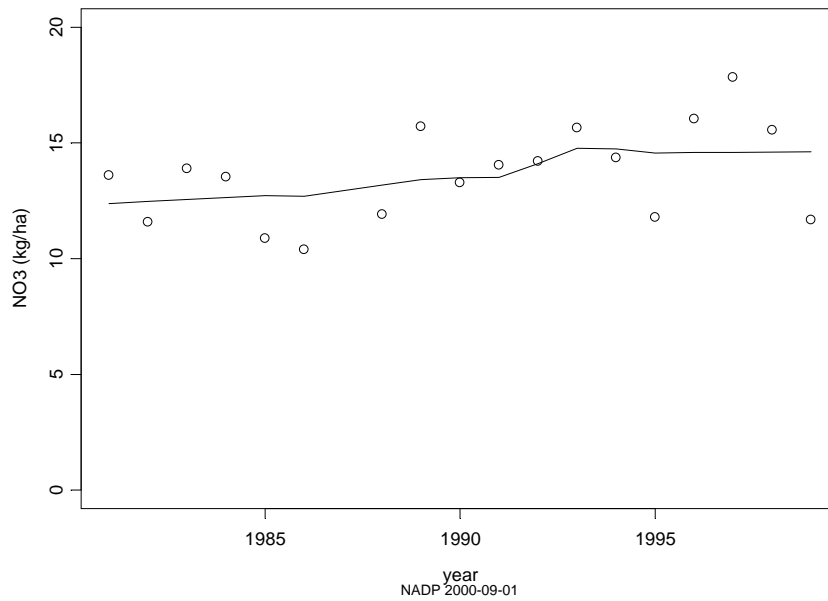


Figure 15. Nitrate Ion Depositions at Elkmont, TN.

### Ozone Concentrations: Bryson City

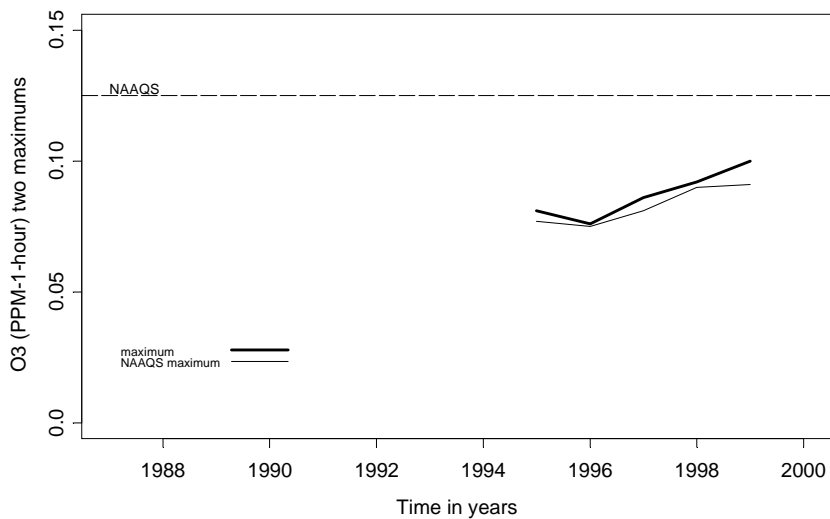


Figure 16. Bryson City, NC: 1-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Bryson City

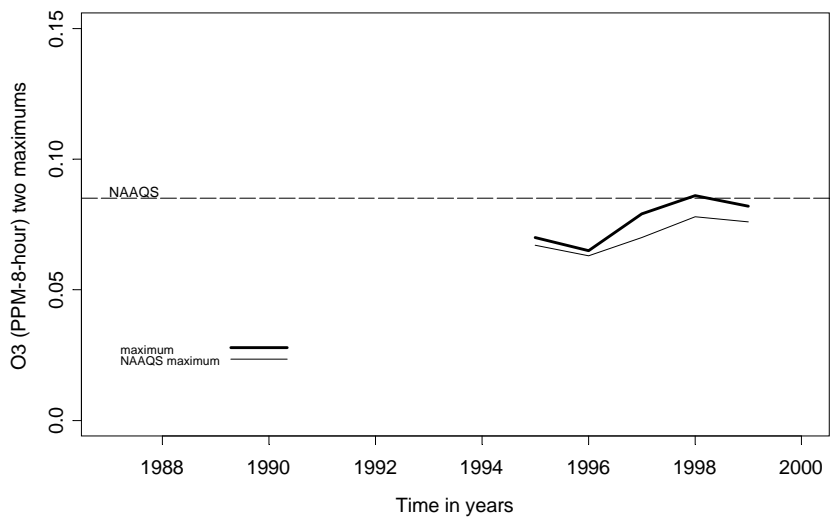


Figure 17. Bryson City, NC: 8-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Cades Cove TN

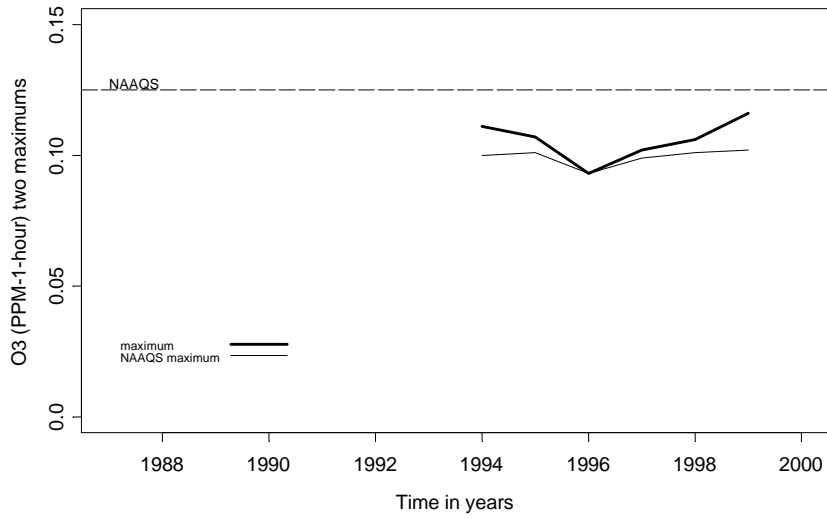


Figure 18. Cades Cove, TN: 1-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Cades Cove TN

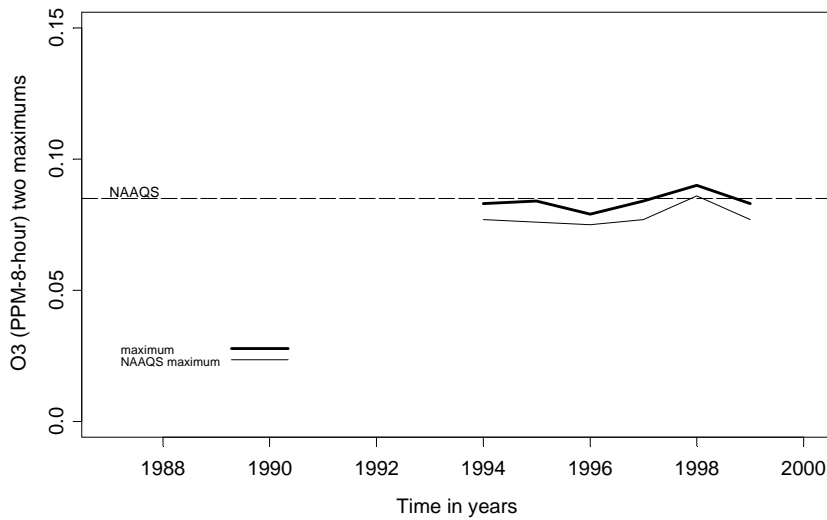


Figure 19. Cades Cove, TN: 8-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Clingmans Dome TN

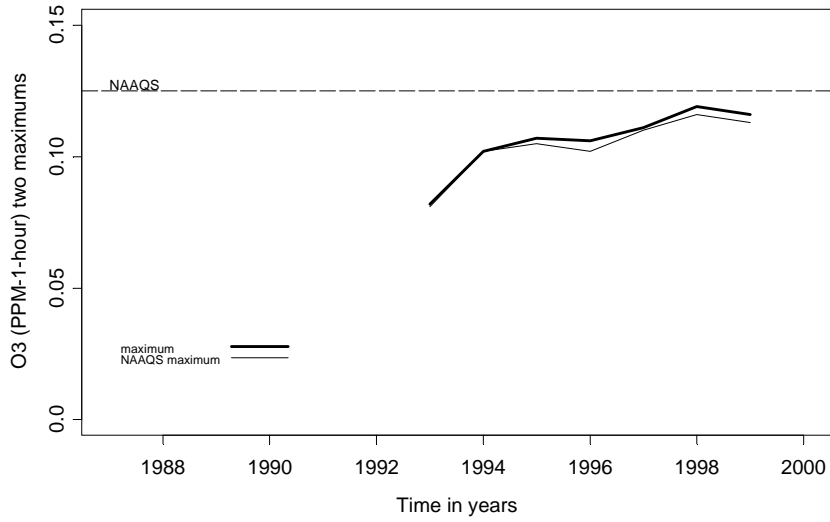


Figure 20. Clingmans Dome, TN: 1-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Clingmans Dome TN

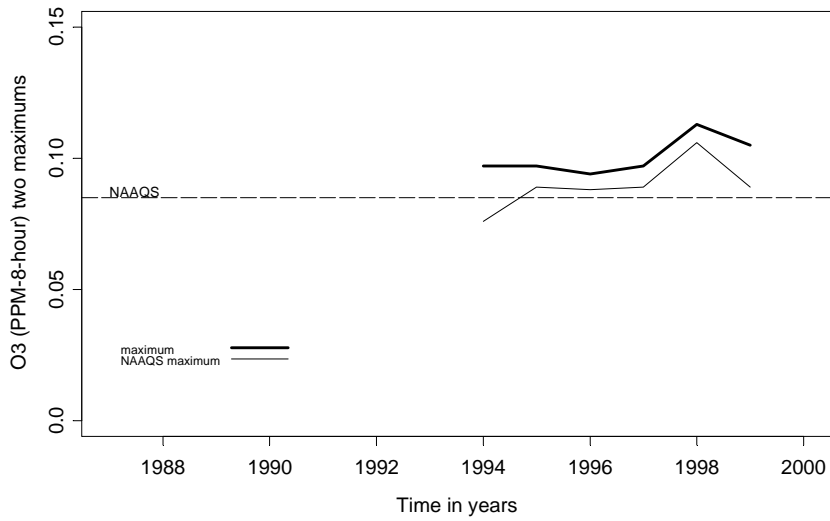


Figure 21. Clingmans Dome, TN: 8-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Cove Mtn TN

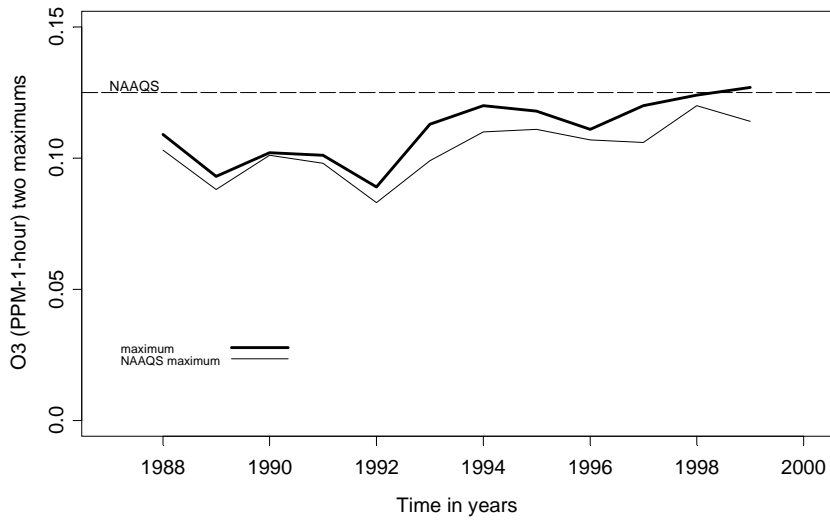


Figure 22. Cove Mtn, TN: 1-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Cove Mtn TN

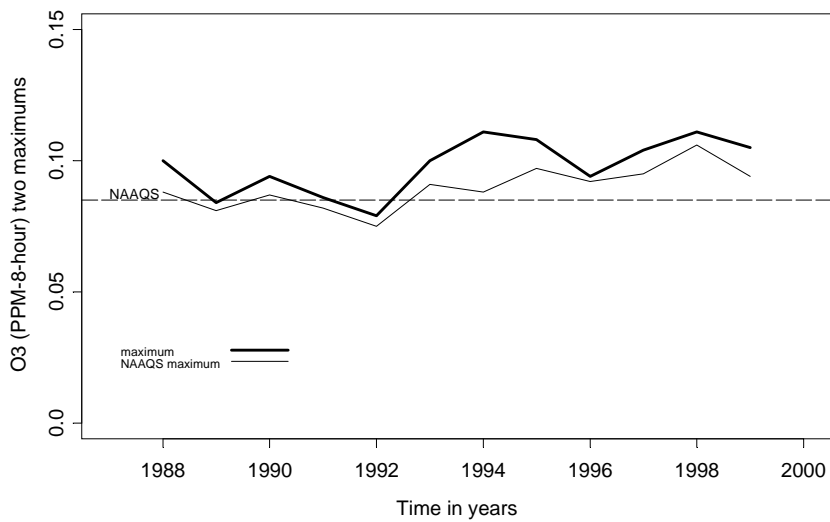


Figure 23. Cove Mtn, TN: 8-Hour Ozone Maximum Concentrations



### Sulfate Ion Concentrations: Coweeta

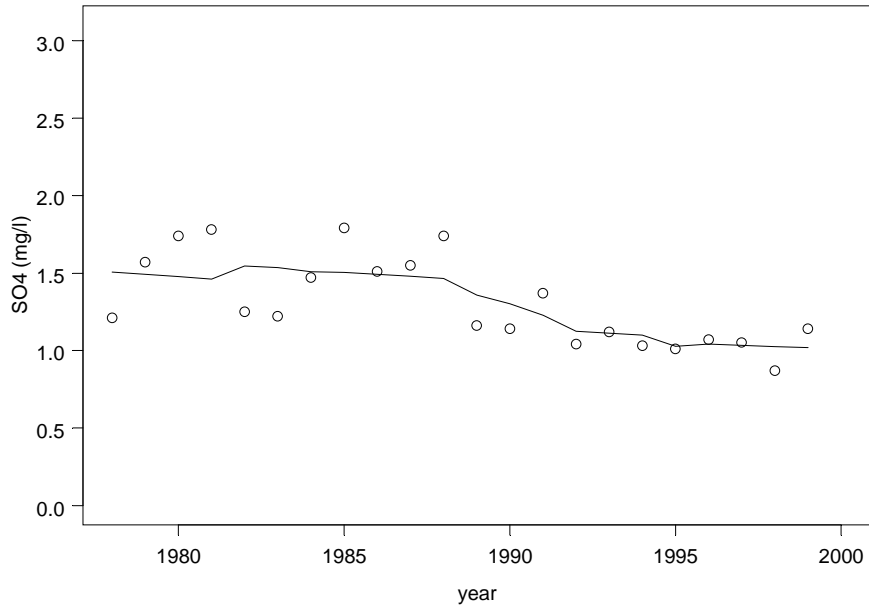


Figure 24. Coweeta, NC: NADP Mean Annual Sulfate Ion Concentration.

### Sulfate Ion Concentrations: Elkmont TN

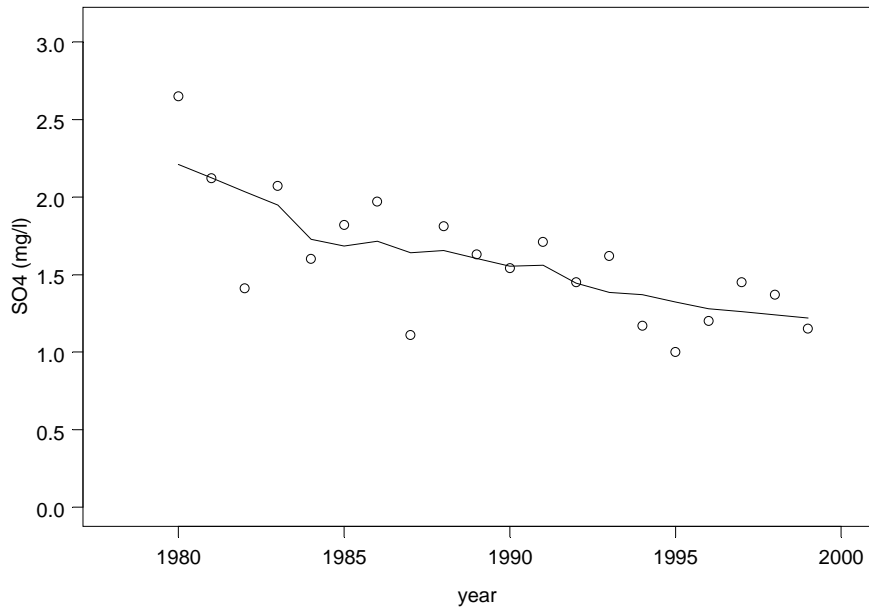


Figure 25. Elkmont, TN: NADP Mean Annual Sulfate Ion Concentration.

### Ozone Concentrations: Fairview/Bent Creek

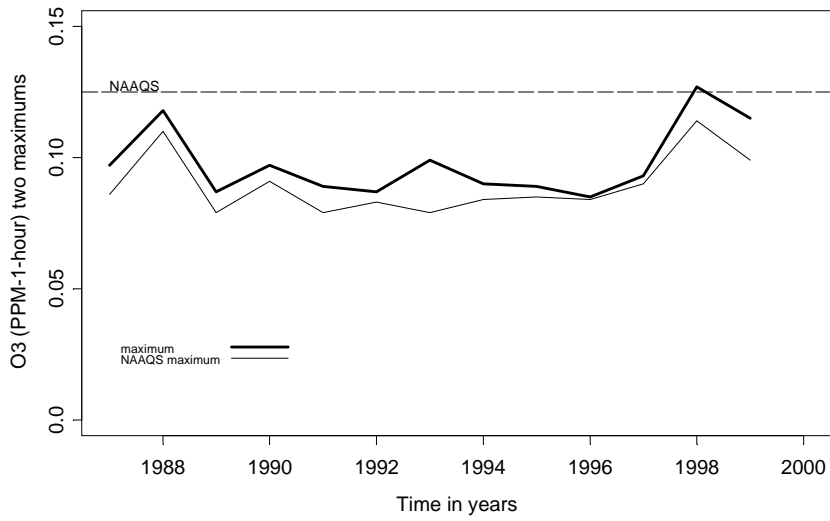


Figure 26. Fairview-Bent Creek, NC: 1-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Fairview/Bent Creek

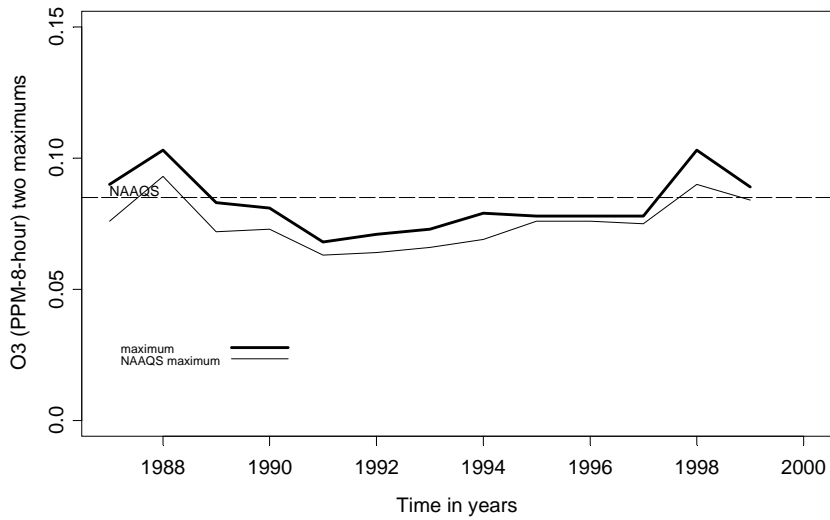


Figure 27. Fairview-Bent Creek, NC: 8-Hour Ozone Maximum Concentrations

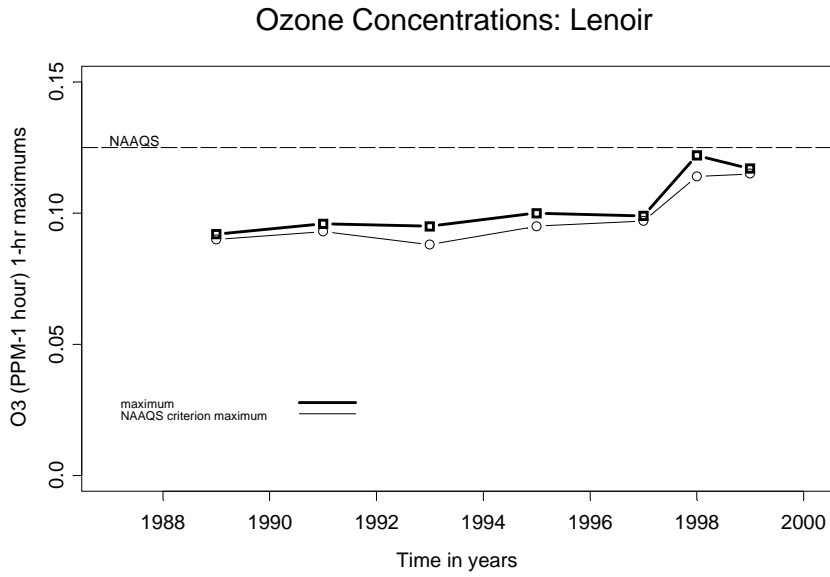


Figure 28. Lenoir, NC: 1-Hour Ozone Maximum Concentrations

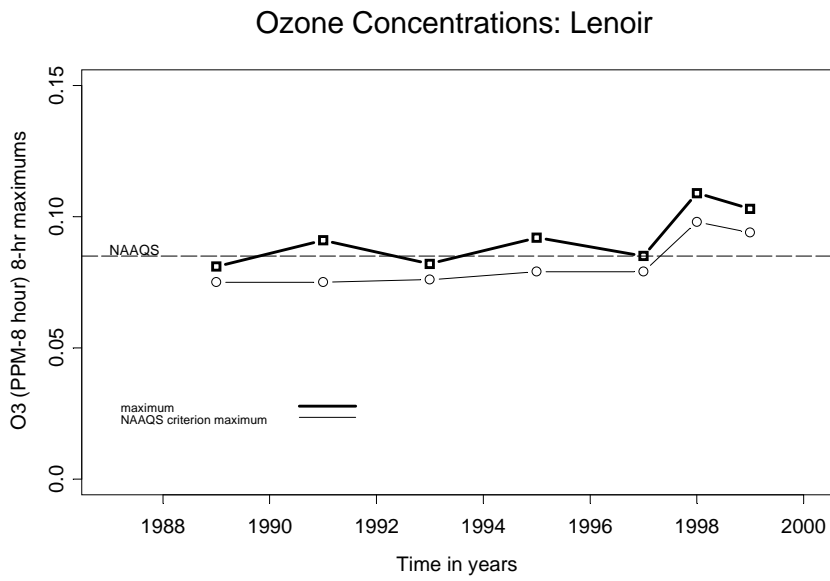


Figure 29. Lenoir, NC: 8-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Look Rock TN

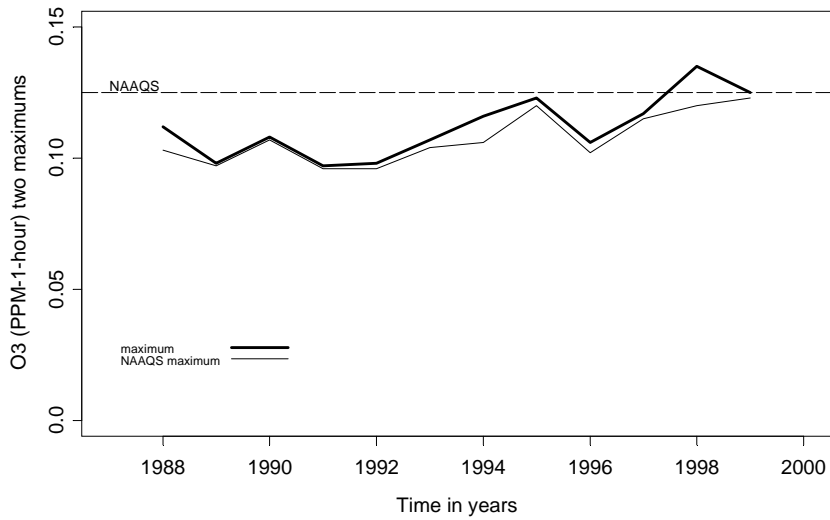


Figure 30. Look Rock, TN: 1-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Look Rock TN

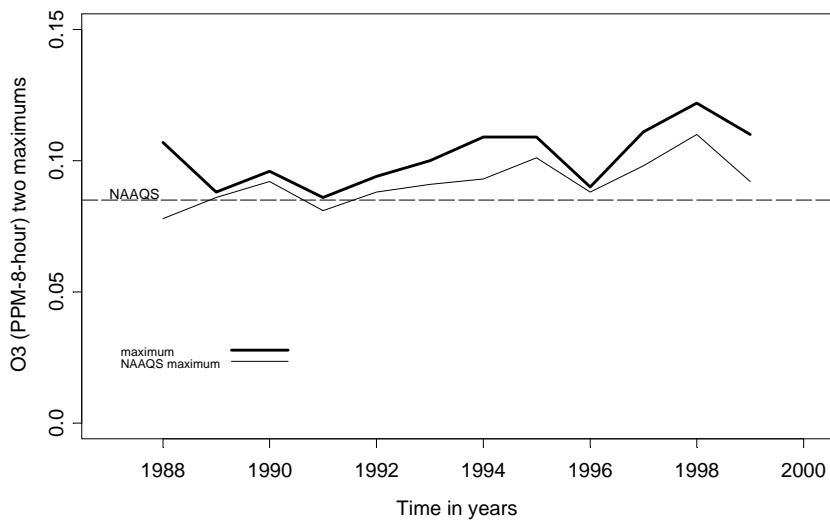


Figure 31. Look Rock, TN: 8-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Mt. Mitchell

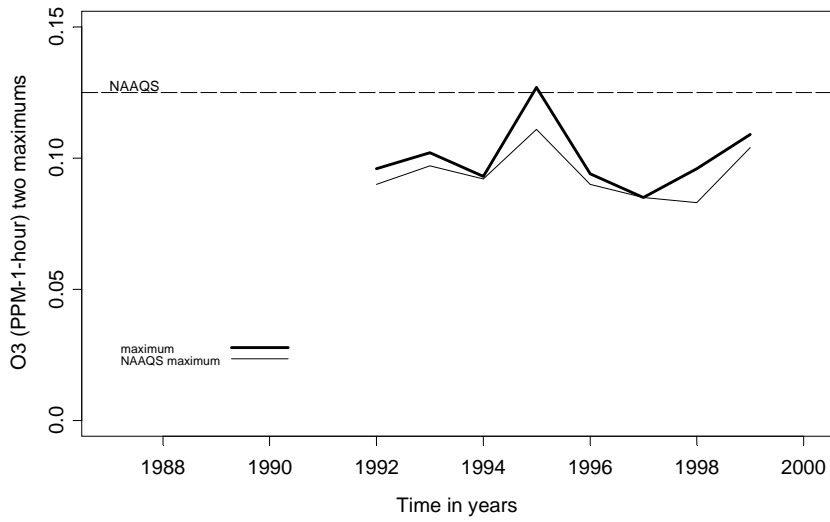


Figure 32. Mt. Mitchell, NC: 1-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Mt. Mitchell

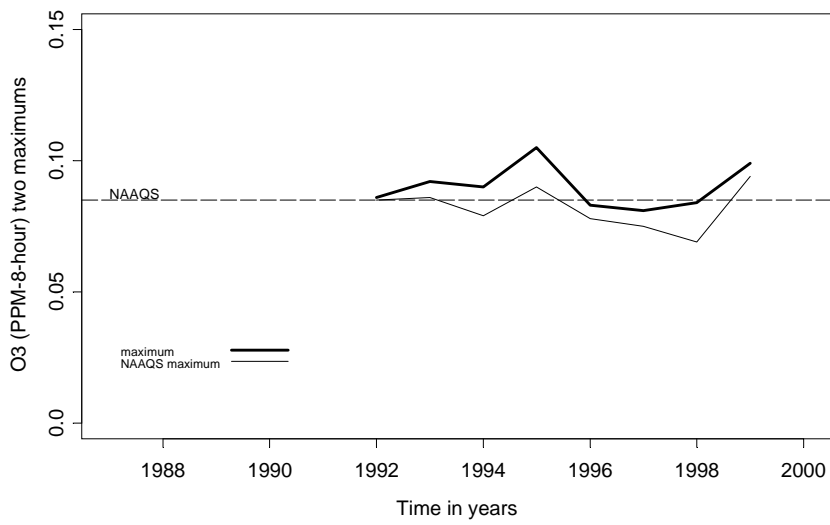


Figure 33. Mt. Mitchell, NC: 8-Hour Ozone Maximum Concentrations

### Sulfate Ion Concentrations: Mt. Mitchell

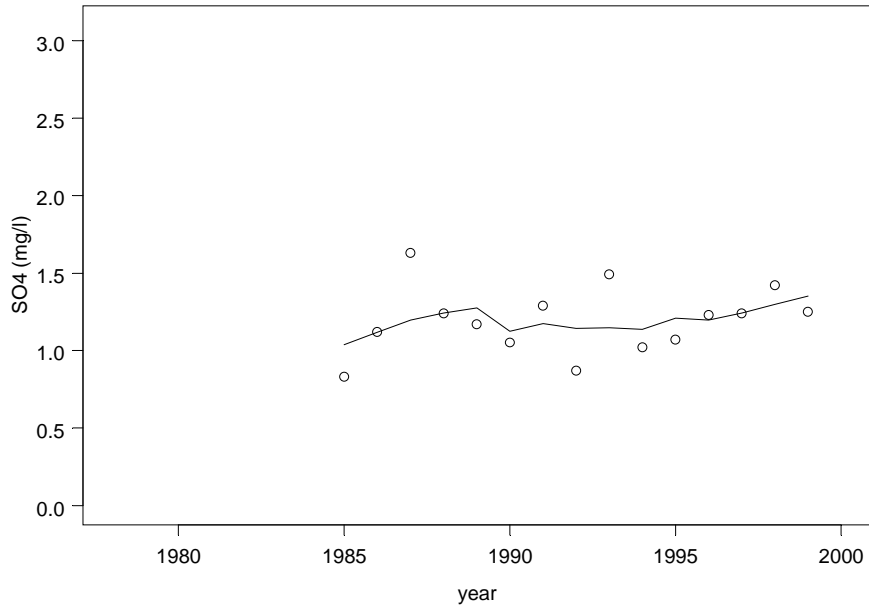


Figure 34. Mt. Mitchell, NC: NADP Mean Annual Sulfate Ion Concentration.

### Ozone Concentrations: Pisg/Frying Pan Mtn

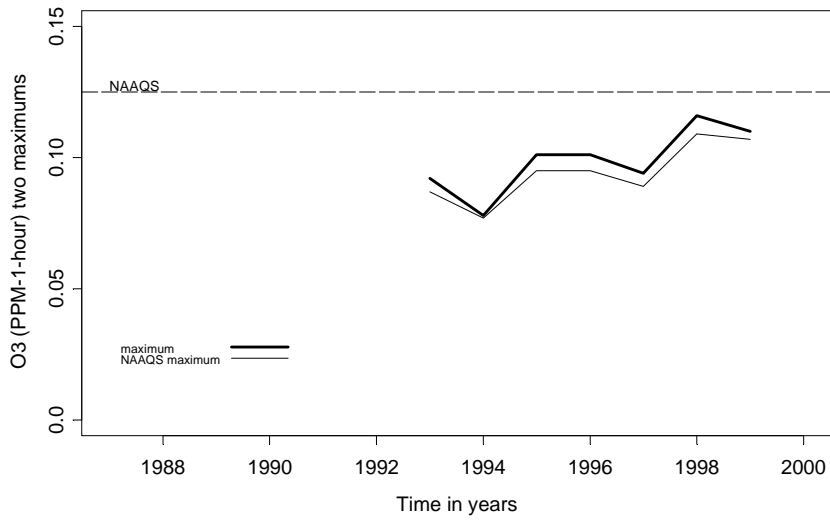


Figure 35. Pisgah-Frying Pan Mtn, NC: 1-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Pisg/Frying Pan Mtn

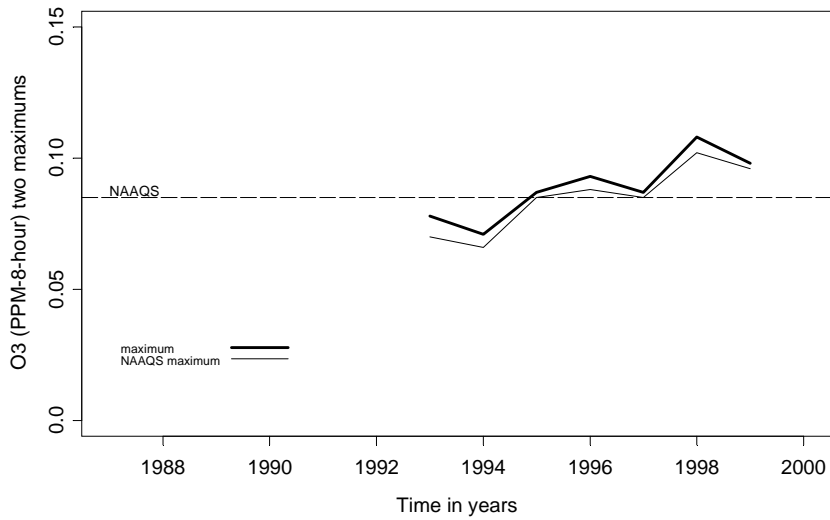


Figure 36. Pisgah-Frying Pan Mtn, NC: 8-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Purchase Knob

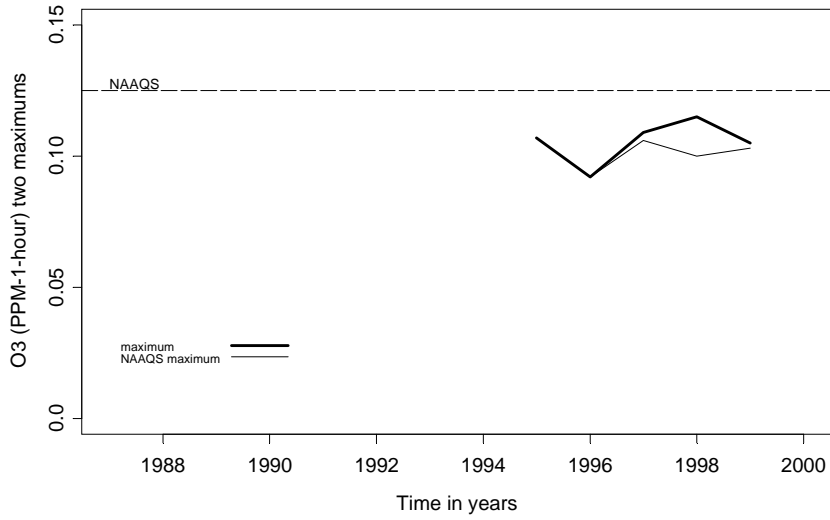


Figure 37. Purchase Knob, NC: 1-Hour Ozone Maximum Concentrations

### Ozone Concentrations: Purchase Knob

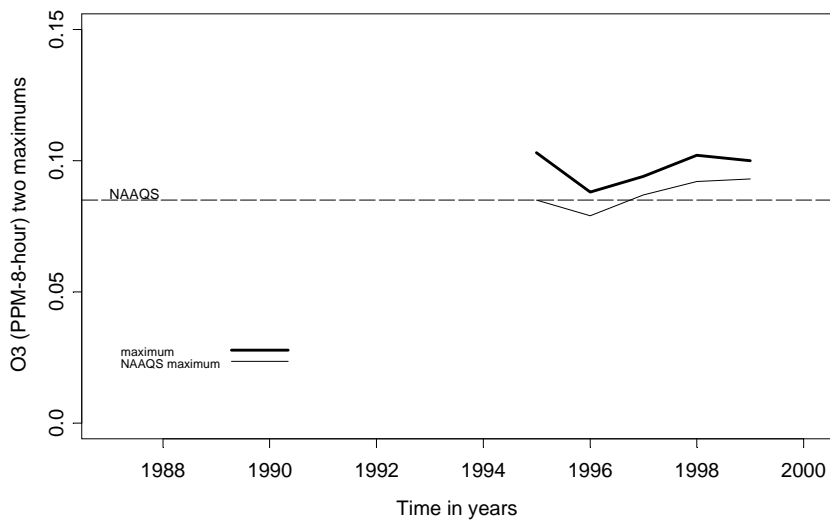


Figure 38. Purchase Knob, NC: 8-Hour Ozone Maximum Concentrations