United States Environmental Protection Agency
Air

Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

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June 1998

GUIDELINE FOR SELECTING AND MODIFYING THE OZONE MONITORING SEASON BASED ON AN 8-HOUR OZONE STANDARD

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Guideline for Selecting and Modifying The Ozone Monitoring Season Based On An 8-Hour Ozone Standard

United States Environmental Protection Agency
Office of Air Quality Planning and Standards
Emissions, Monitoring, and Analysis Division
Research Triangle Park, NC 27711
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Executive Summary

This document provides guidance for the EPA Regional Offices to select and modify the ozone monitoring seasons designated for each State in the Code of Federal Regulations (40 CFR 58, Appendix D). The guidance may be summarized as follows:

1. From AIRS, examine all ozone monitoring stations that collected data during the past 6-year period (in this case 1990-1995 was used). For each State and Territory, determine the number of days in each month, summed over the 6 years, in which at least one 8-hour average ozone concentration exceeded 0.080 ppm; by using a value of 0.080 ppm rather than 0.08 as articulated in the revised National Ambient Air Quality Standard (NAAQS) for ozone, a degree of conservatism is introduced which ensures that monitoring occurs during months that have the potential to violate the NAAQS.

2. Prepare a histogram of these values (See Appendix A of this document) for each State or Territory. Choose a proposed ozone monitoring season which would be defined as the continuous period that includes all months showing at least one 8-hour average concentration $\geq$ 0.080 ppm.

3. Extrapolate the ozone monitoring season to States and Territories for which data are insufficient based on similarities in climatology. For each State and Territory not covered by a monitoring histogram, this procedure produces an estimated histogram from which a proposed ozone monitoring season is derived.

4. Table 2. depicts the proposed ozone monitoring season for each State and Territory based on this analysis and compares it to the existing ozone monitoring season.

5. Adjust the ozone monitoring seasons as follows (see also Table 2.):

   a. Choose an appropriate composite monitoring season which includes both the 1-hour and 8-hour monitoring seasons if both NAAQS still apply.
   b. If the 1-hour NAAQS has been revoked, choose the 8-hour monitoring season as a replacement for the 1-hour or "composite" monitoring season.
   c. Adjust the monitoring seasons in neighboring States to reflect similar seasons in areas of transport or within EPA Regional boundaries.[1] Adjustments should only be made to lengthen the ozone monitoring season, rather than to shorten it.

6. Make appropriate changes to the **Code of Federal Regulations** (CFR):

   All official changes to the ozone monitoring season which will affect State and Local Air Monitoring Stations (SLAMS) and National Air Monitoring Stations (NAMS) in a county, group of counties, or entire State must be promulgated as changes to 40 CFR 58 to modify the table in Appendix D to 40 CFR 58, entitled "Ozone Monitoring Season by State". The Regional Administrator is responsible for coordinating changes to the ozone season with each affected State and he/she will prepare a rulemaking package and publish it the ***Federal Register*** notice. Note that either the State, the EPA Regional Office, or EPA Headquarters may request that a State's ozone season be revised and the attendant data analysis and review be initiated. Any changes which affect NAMS, must be concurred with by the Office of Air Quality Planning and Standards (OAQPS). This concurrence will promote national consistency in ozone monitoring and also ensure that appropriate changes will be made to the Aerometric Information Retrieval System (AIRS) such that statistics are appropriately calculated. It is also suggested that changes to scheduled ozone monitoring seasons should be incorporated into the comment section of the monitoring site file on AIRS, for all affected monitors.

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[1] Kantz, Marcus, Interoffice Memorandum, March 5, 1997.

1.0 Introduction and Background

Seasonal ozone monitoring requirements at State and Local Air Monitoring Stations (SLAMS) [which by definition include the National Air Monitoring Stations (NAMS)] were first introduced into regulation in 1986. Since that time, modifications to the original ozone monitoring seasons have been made periodically as new data and information became available; each of these changes has been incorporated into existing ambient air monitoring regulations[2]. These seasons are important because they play a significant role in the estimation of annual ozone NAAQS exceedances and provide the basis for calculations in the Aerometric Information Retrieval System (AIRS) summary files. The monitoring seasons may also be tied to certain State emission regulations.

For the initial formulation of the ozone monitoring seasons for each State, the District of Columbia, and Territories held by the United States, the monthly ranges were principally based on empirically-derived relationships between monthly mean daily maximum temperature and observed peak ozone concentrations. The basic premise was that areas with monthly mean maximum temperatures predominantly below 55 degrees Fahrenheit (°F) are expected to have hourly ozone concentrations less than 0.08 ppm (i.e., significantly less than the hourly ozone standard of 0.12 ppm). This relationship was determined empirically from observed ozone concentrations and indicated by smog chamber studies.[3]

With the 1997 revisions to the National Ambient Air Quality Standards (NAAQS) for ozone (i.e., the addition of a maximum 8-hour average ozone concentration of 0.08 ppm; see Appendix C to this document), it has become necessary to redefine the ozone monitoring season for purposes of demonstrating attainment. The principal motivation is to develop an understanding of the characteristics of the ozone monitoring season based on the new standard. Another motivation for this guideline document is that reductions in required monitoring can

[2] 40 CFR 58, Appendix D, Section 2.5

[3] The 1-hour 0.12 ppm ozone standard was in place in 1979, before the establishment of ozone seasons.

result in considerable cost savings. If the ozone monitoring season in any particular State can be shortened even 1 month, significant potential savings could be realized.

Unlike previous techniques to define the ozone monitoring season, the technique adopted by this study relies principally on six years of observed data from the SLAMS (including NAMS) networks, in this case, for the period 1990-1995; these data are used to derive the statistics for each State. Any extrapolation of the results was performed based on similarities in climatology. Section 2. describes the methodology, Section 3. presents the resulting table of ozone monitoring seasons by States, and Section 4. discusses the criteria for revising the ozone monitoring season.

2.0 Methodology

The specific steps in the method used to determine the ozone monitoring season are based on existing data and the 8-hour average ozone standard of 0.08 ppm; these steps are outlined below:

1) Twenty-four 8-hour average ozone concentrations were calculated for each day and station in the United States and its Territories using hourly data from the Aerometric Information Retrieval System (AIRS) database for the 6-year period 1990-1995. From this database, a second data set containing the peak 8-hour average concentrations for each day was assembled.

2) The peak 8-hour average ozone concentrations for each station were examined and when concentrations $\geq$ 0.080 ppm were found, the day, month, and concentration values were recorded. Note that the 8-hour standard includes a rounding procedure that rounds 0.084 ppm down and 0.085 ppm up.[4] The chosen approach to establish the ozone monitoring season, however, incorporates a more conservative approach and defines exceedances as $\geq$

[4] 40 CFR 50, Appendix I, Section 2.3

0.080 ppm rather than 0.085 ppm. This convention ensures that time periods which have the potential to exceed .085 ppm are included in the monitoring season.

3) These data were used to construct State-by-State histograms[5] for the months in which the 8-hour concentrations were ≥ 0.080 ppm in the 6-year period 1990-1995 using all available data (i.e., in AIRS) for each State.

4) Since an uninterrupted monitoring season should be adopted which will capture all the potential daily maximum 8-hour average ozone concentrations ≥ 0.085 ppm, the ozone season for the 8-hour NAAQS would be defined for each State from these histograms as beginning with the first month with 8-hour values ≥ 0.080 ppm and ending with the last month with 8-hour values ≥ 0.080 ppm. For example, Table 1. is a summary table of the frequency of 8-hour values ≥ 0.080 ppm for the State of Illinois and shows that values ≥ 0.080 ppm occurred from April through September. The ozone monitoring season for Illinois would then be defined as the period April through September, April being the first month with values ≥ 0.080 ppm and September being the last month with values ≥ 0.080 ppm.

Table 1. Summary Table of the Number of Daily 8-Hour Concentrations ≥ 0.080 ppm as a Function of Month for the State of Illinois.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	0	0	0	1	61	482	197	204	58	0	0	0

5) Extrapolation of ozone monitoring seasons adopted from the histogram data to States where data do not exist was principally based on similarities in climatology. The climatological data used for this part of the project were monthly wind rose data, monthly maximum, minimum, and average surface temperature data, and monthly average

[5]See Appendix A to this guideline.

precipitation data provided in the Climatic Atlas for the United States (1997) and Local Climatological Data (LCD) for the period 1900-1995 (National Climate Date Center, 1997).

For a given station, the 24 8-hour averaged ozone concentrations for a given day were calculated as shown in Appendix B to this guideline

3.0 Results

Table 2. provides the 8-hour ozone monitoring seasons for each State based on the histogram data located in Appendix A to this guideline and contains comparisons to the current ozone season based on the 1-hour NAAQS. This table also contains the "adjusted" 8-hour monitoring seasons discussed in Section 4. of this document. Figure 1. shows the current ozone monitoring seasons based on the 1-hour standard; Figure 2. depicts the seasons for the 8-hour NAAQS which result from following the guidance in this document; and Figure 3. displays the 8-Hour ozone monitoring seasons following an adjustment for regional uniformity. Section 4.0, "Criteria for Revisions of the Ozone Monitoring Season" explains the methodology for calculating a new ozone monitoring season.

Table 2. Ozone Monitoring Seasons Based on the 1-Hour and 8-Hour NAAQS

State	A - Season Based on the 1-hour NAAQS[1]	B - Season Based on the 8-Hour NAAQS	Difference (B-A) (Months)	C - Adjusted 8-Hour Monitoring Season[5]	Difference (C-A) (Months)
Alabama	April - October	March - October	+1	March - October	+1
Alaska[2]	April - October	June - September	-3	June - September	-3
Arizona	January - December	April - October	-5	April - October	-5
Arkansas	March - November	March - October	-1	March - October	-1
California	January - December	January - December	0	January - December	0
Colorado	March - September	May - September	-2	May - September	-2
Connecticut	April - September	April - October	+1	April - October	+1
Delaware	April - October	April - October	0	April - October	0
District Of Columbia	April - October	April - September	-1	April - October	0
Florida	January - December	March - October	-4	March - October	-4
Georgia	April - October	March - September	0	March - October	+1
Hawaii[3]	January - December	January - December	0	January - December	0
Idaho[2]	April - October	June - September	-3	June - September	-3
Illinois	April - October	April - September	-1	April - October	0
Indiana	April - September	April - October	+1	April - October	+1
Iowa	April - October	May - September	-2	May - September	-2
Kansas	April - October	April - September	-1	April - October	0
Kentucky	April - October	April - October	0	April - October	0
Louisiana	January - December	January - November	-1	January - November	-1
Maine	April - September	April - October	+1	April - October	+1
Maryland	April - October	April - September	-1	April - October	0
Massachusetts	April - September	April - October	+1	April - October	+1
Michigan	April - September	April - October	+1	April - October	+1
Minnesota	April - October	May - August	-3	May - September	-2
Mississippi	April - October	March - October	+1	March - October	+1
Missouri	April - October	April - October	0	April - October	0
Montana[4]	June - September	June - September	0	June - September	0
Nebraska	April - October	June -September	-3	June -September	-3
Nevada	January - December	January - August	-4	January - August	-4
New Hampshire	April - September	May - September	-1	April - October	+1
New Jersey	April - October	April - October	0	April - October	0
New Mexico	January - December	June - October	-7	April - October	-5
New York	April - October	April - October	0	April - October	0
North Carolina	April - October	April - October	0	April - October	0
North Dakota[2]	May - September	June - September	-1	June - September	-1
Ohio	April - October	April - October	0	April - October	0
Oklahoma	March - November	March - October	-1	March - October	-1
Oregon	April - October	May - September	-2	May - September	-2
Pennsylvania	April - October	April - September	-1	April - October	0
Puerto Rico[3]	January - December	January - December	0	January - December	0
Rhode Island	April - September	April - September	0	April - October	+1
South Carolina	April - October	April - November	+1	April - November	+1
South Dakota[2]	June - September	June - September	0	June - September	0
Tennessee	April - October	April - November	+1	April - November	+1
Texas	Jan-Dec & Mar-Oct.	January - November	-1/+3	January - November	-1
Utah	May - September	May - September	0	May - September	0
Vermont	April - September	April - October	+1	April - October	+1
Virginia	April - October	April - September	-1	April - October	0
Washington	April - October	May - August	-3	May - September	-2
West Virginia	April - October	April - October	0	April - October	0
Wisconsin	April 15-October 15	April - October	+1	April - October	+1
Wyoming[2]	April - October	June - September	-3	June - September	-3
American Somoa[4]	January - December	January - December	0	January - December	0
Guam[4]	January - December	January - December	0	January - December	0
Virgin Islands[4]	January - December	January - December	0	January - December	0
Total Months	430	385	-45	399	-31

[1]40 CFR 58, Appendix D.

[2]Default values for the continental United States, including Alaska, have been used for this State.

[3]Default values for the tropical latitudes have been used for this State or Territory.

[4]No data were available for this State or Territory and the ozone monitoring season was based on climatology.

[5]Ozone monitoring seasons for certain States were adjusted to match ozone seasons in neighboring States within transport regions and to better reflect months with ozone conducive meteorology. Specifically, the following adjustments were made: the ozone monitoring seasons were extended in the States of New Hampshire, Rhode Island, Georgia, Illinois, Minnesota, Washington, Pennsylvania, Maryland, District of Columbia, Virginia, and New Mexico.

Table 3. lists the States having no 8-hour values $\geq$ 0.080 ppm over the 6-year period 1990-1995. For those States having no exceedances found in the continental United States, including Alaska, a default ozone monitoring season of June through September, the heart of the summer or growing season, was applied. For the States or Territories (i.e., Hawaii, Puerto Rico, Guam, American Somoa, and the Virgin Islands) in the tropical latitudes, the default ozone monitoring season was January through December because meteorological conditions (i.e., temperature, winds, etc.) are conducive to creating an episode on a year around basis at those latitudes.

Table 3. States and Territories with No 8-Hour Values $\geq$ 0.080 ppm.

Alaska	**Hawaii**
Idaho	**North Dakota**
Puerto Rico	**South Dakota**
Wyoming	

Montana, Guam, American Somoa, and the Virgin Islands were States/Territories for which data were not available to create histograms of 8-hour values $\geq$ 0.080 ppm. Based on the Climatic Atlas for the United States (1997) and the LCDs (National Climatic Data Center, 1997) for Montana and the surrounding region, Montana has a climate similar in aspects to North Dakota, South Dakota, Wyoming, and Idaho, all of which border Montana. North Dakota, South Dakota, Wyoming, and Idaho are listed in Table 3. as having no 8-hour ozone values $\geq$ 0.080 ppm so that the default ozone monitoring season of June through September was applied. Based on climatology, the ozone monitoring season of June through September was also applied to Montana.

4.0 Criteria for Revisions of the Ozone Monitoring Season

According to the provisions of 40 CFR 58.13(a)(3), the Regional Administrator (RA) has the authority to exempt particular periods or seasons from the requirements to collect ambient air quality data at SLAMS. Appendix H of 40 CFR 50 also mentions such waivers for continuous ozone monitoring requirements areas where it can be demonstrated that exceedances of the ozone NAAQS are extremely unlikely. Such exemptions or waivers take the form of a formal change to 40 CFR 58, Appendix D, published as a final rule in the Federal Register by the RA. For example in April 1989, Region VI officially modified Texas' ozone monitoring season which was originally designated as the entire year, by publishing a notice of change in the Federal Register. Since this change involved NAMS, it was coordinated with EPA headquarters. The RA revised the ozone monitoring season to a 245 day time period of March - October for the seven more northern regions of Texas.

The primary objective for ozone monitoring is protection of public health and the determination of all ambient concentrations greater than the level of the NAAQS. Accordingly, a simple rule may be followed to determine the seasonal requirement for ozone monitoring: any location for which an ozone monitor is determined to be necessary, an uninterrupted particular time of the year must be monitored if it has the potential for ozone exceedances.

There are two basic constraints regarding time and geographic coverage. As in the case for the 1986 promulgated ozone monitoring seasons, the period of required monitoring must be uninterrupted (e.g., April through November). The required monitoring period cannot have any gaps (e.g., it cannot be April through September plus November). Single counties should not have different ozone seasons; instead, seasons should be crafted for multi-county areas. In particular, ozone nonattainment areas comprised of multiple counties, should have the same ozone monitoring seasons to avoid questions during ozone attainment reviews and enforcement/sanction actions. It is also suggested that EPA Regional Offices with States located in the ozone transport regions consider having the same or similar ozone monitoring seasons to make data analysis more meaningful. At most, two regions within each State would be acceptable; this alternative is principally intended for large States (e.g., Texas and California).

The following discussion will focus on procedures to justify changes in the current ozone seasons. States are encouraged to review the duration of their current ozone monitoring season as part of their annual network review. With the significant amount of monitoring being performed in most States and Territories, the potential for ozone exceedances can be determined using the ozone monitoring data available for the State or Territory. In those few cases where ozone monitoring data are not available, application of results from areas with similar climatological conditions and underlying precursor emissions is recommended.

Ambient concentrations produced in a monitoring area can provide the basis for revisions to existing ozone monitoring seasons. A review of historical ozone data for this purpose must be based on 6 years of the most recent data, to ensure that both favorable and unfavorable meteorological conditions are represented. In addition, these data should be representative of both current and expected near-term future conditions. This will help to anticipate the effects of possible growth in ozone precursor emissions.

Historical ozone data would be examined using the histogram approach outlined in Section 2. Based on the outcome of such a review, ozone monitoring must be maintained during those calendar periods in which the 8-hour averaged ozone concentration $\geq$ 0.080 ppm have been observed and therefore has the potential to exceed the 8-hour NAAQS of 0.08 ppm. To capture those periods when the 8-hour values may be $\geq$ 0.08 ppm, the ozone season should be defined from these histograms as beginning with the first month with 8-hour values $\geq$ 0.080 ppm and ending with the last month with values $\geq$ 0.080 ppm. If because of urban growth or meteorological conditions or both, 8-hour values $\geq$ 0.080 ppm begin to appear at the boundaries of the designated ozone monitoring season, the ozone monitoring season should be extended one month beyond the designated boundary of the season. For example, the present analysis indicates that the ozone monitoring season for Illinois after adjustment is April through October (See Table

2.). If in the future, 8-hour values $\geq$ 0.080 ppm are found in early April and data are not available prior to April, then the RA should consider extending the ozone monitoring season to include March. It is recommended that the historical data should be reviewed every three years after any change in season is made to see if a further extensions are required. Similarly, if no 8-hour values $\geq$ 0.080 ppm are found in April[6], then the ozone monitoring season should be revised to May through October.

If a State does not collect ozone data and changes in the ozone monitoring season have been observed for States that have similar climatology, then those changes in the ozone monitoring season should also be implemented for the State that does not collect ozone data. For example, if identical changes in the ozone monitoring season were noted for North Dakota, South Dakota, Wyoming, and Idaho, which monitor ozone, then a similar change should be implemented in the ozone monitoring season for Montana which does not presently collect ozone data, but which has a similar climatology as North Dakota, South Dakota, Wyoming, and Idaho according to the Climatic Atlas for the United States (1997).

Additionally, ozone monitoring seasons may be adjusted to reflect similar seasons in areas of transport or within EPA Regional boundaries. This will simplify not only the management of the ozone monitoring program, but will also ensure that data is being procured in neighboring States for later comparisons. Table 2. and Figure 3. illustrate calculated ozone seasons based on the 8-hour NAAQS and seasons adjusted for regional uniformity, respectively; note that for these purposes, seasons were only adjusted upward, i.e., the longer period was chosen. When any area is subject to both the 1-hour and 8-hour NAAQS, the monitoring season should also reflect the longer of the two periods, or a different period which would overlap the sum of the two. For example:

[6]Note that only one value $\geq$ 0.080 ppm was found for Illinois in April in the 6-year period 1990-1995.

If a State's 1-hour ozone monitoring season was April to October and its 8-hour season was April to November, the appropriate composite season would be April to November. If the 1-hour season was April to October and the 8-hour season was May to November, the appropriate choice would be April to November.

REFERENCES

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US Department of Commerce, Climatic Atlas for the United States, NOAA, 80 pg., 1997

US EPA, Guideline on Modification to Monitoring the Seasons for Ozone. Technical Support Division, OAQPS, 47 pg., March 1990.

Kantz, Marcus, Interoffice Memorandum, March 5, 1997.

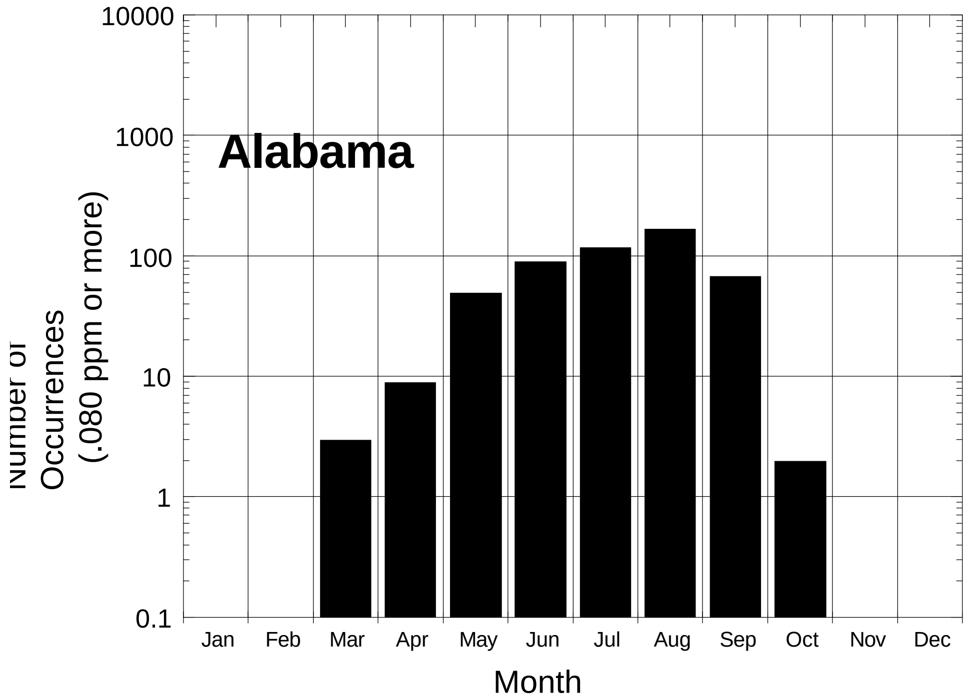
Science Applications International Corporation, Guideline for Selecting and Modifying the Ozone Monitoring Season, A Report Prepared for the US EPA, Raleigh, North Carolina, January 1997.

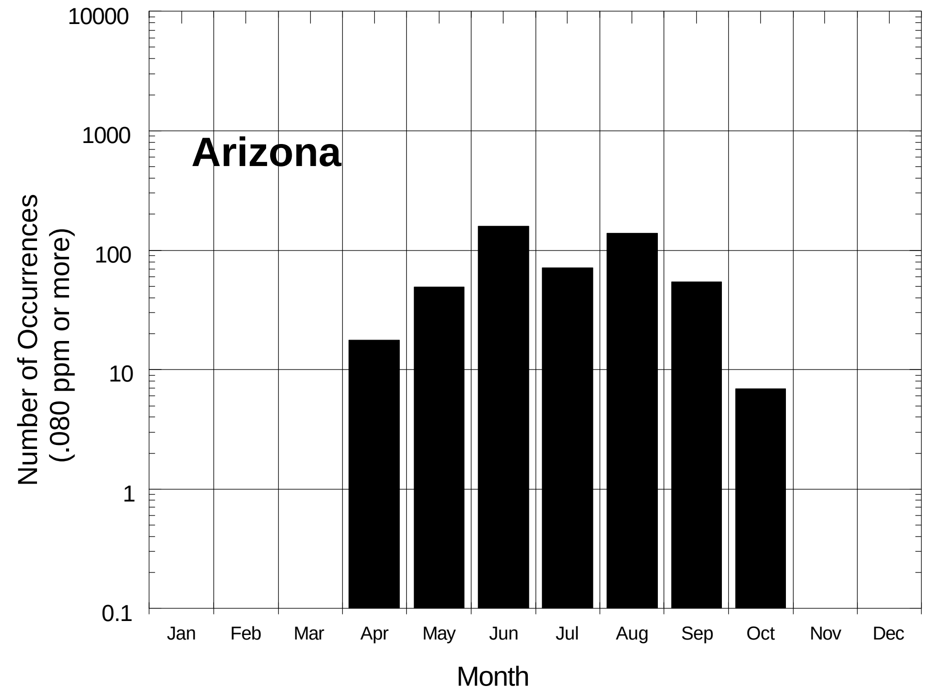
Appendix A

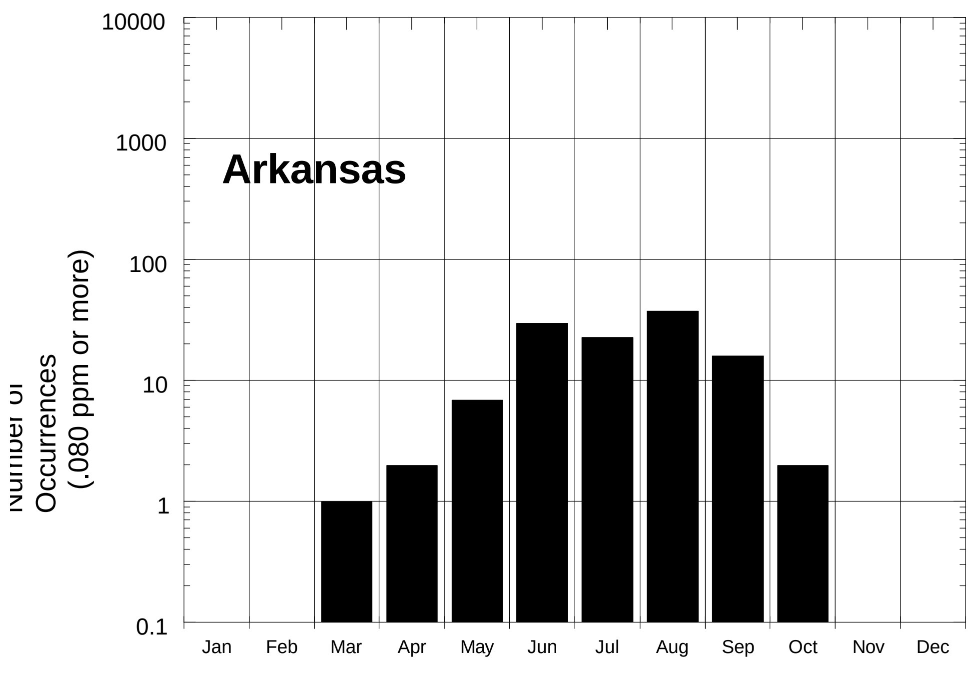
Histograms

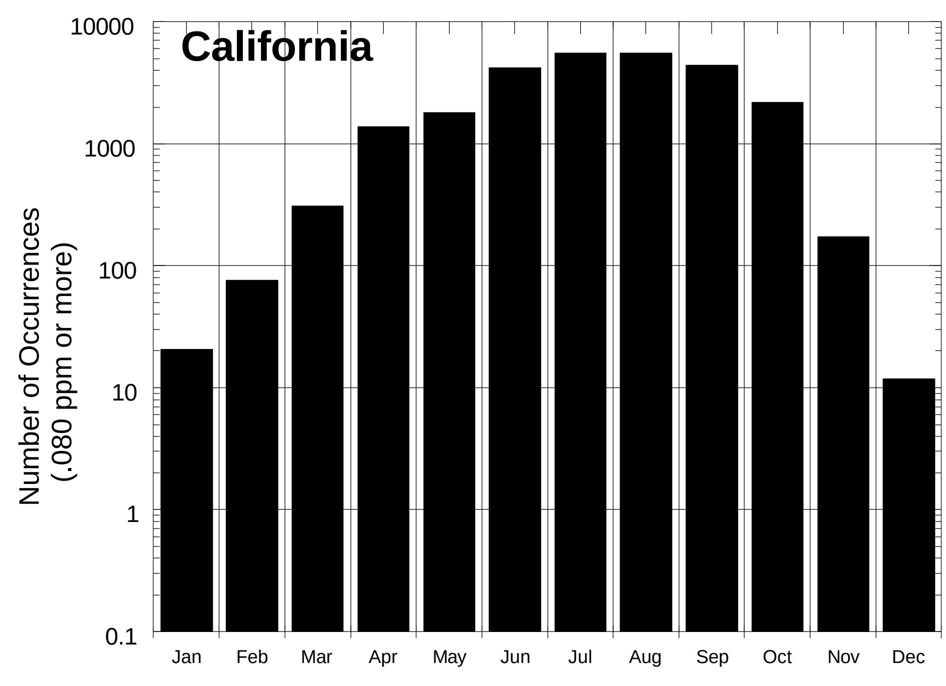
In the following appendix, the histograms of the daily maximum 8-hour averaged ozone concentrations that are $\geq$ 0.080 ppm are presented. A histogram is presented for each State and Territory that collected ozone data from 1990 through 1995 and that had one or more 8-hour values $\geq$ 0.080 ppm[1].

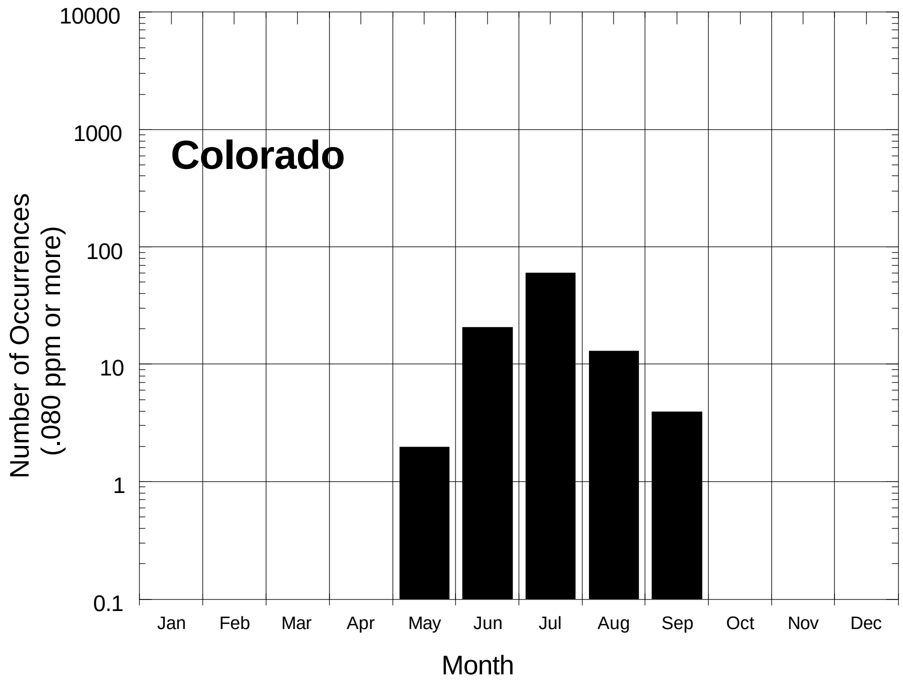
1-Histograms could not be created for those States that did not collect ozone data for the analysis period, specifically Montana. Ozone data has been reported for Alaska, Idaho, Hawaii, North Dakota, Puerto Rico, South Dakota, and Wyoming; however, none of these monitors showed 8-hour averaged ozone values $\geq$ 0.080 ppm.


Alabama
Occurrences
(.080 ppm or more)
10000
1000
100
10
1
0.1
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month


Arizona
Number of Occurrences
(.080 ppm or more)
10000
1000
100
10
1
0.1
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month


Arkansas
Occurrences
(.080 ppm or more)
10000
1000
100
10
1
0.1
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


California
Number of Occurrences
(.080 ppm or more)
10000
1000
100
10
1
0.1
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


Colorado
Number of Occurrences (.080 ppm or more)
10000
1000
100
10
1
0.1
Jan
Feb
Mar
Apr
May
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Jul
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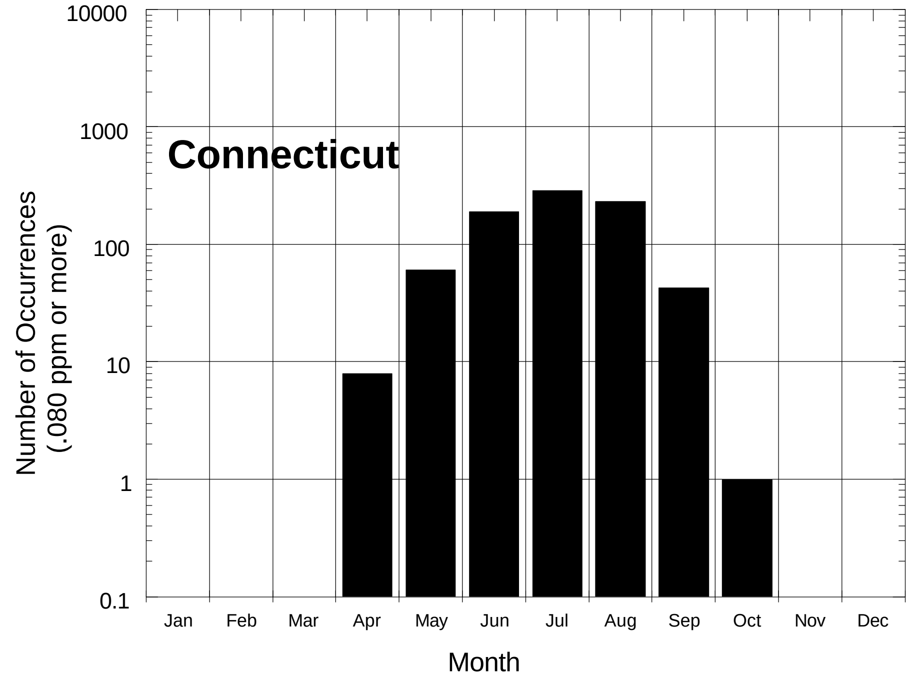
Sep
Oct
Nov
Dec
Month


Connecticut
Number of Occurrences (.080 ppm or more)
10000
1000
100
10
1
0.1
Jan
Feb
Mar
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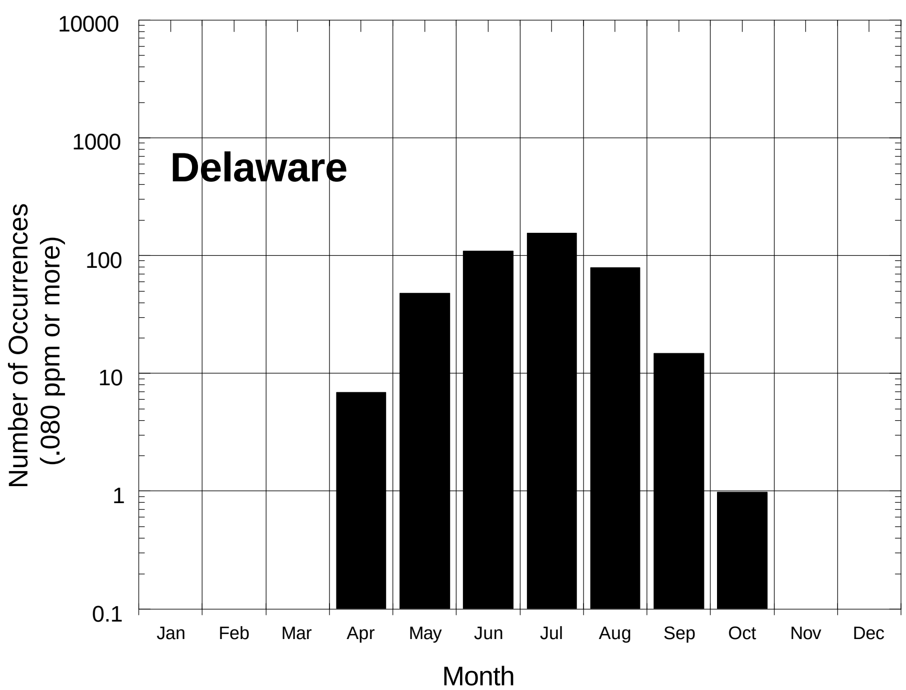
Month


Delaware
Number of Occurrences (.080 ppm or more)
10000
1000
100
10
1
0.1
Jan
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Aug
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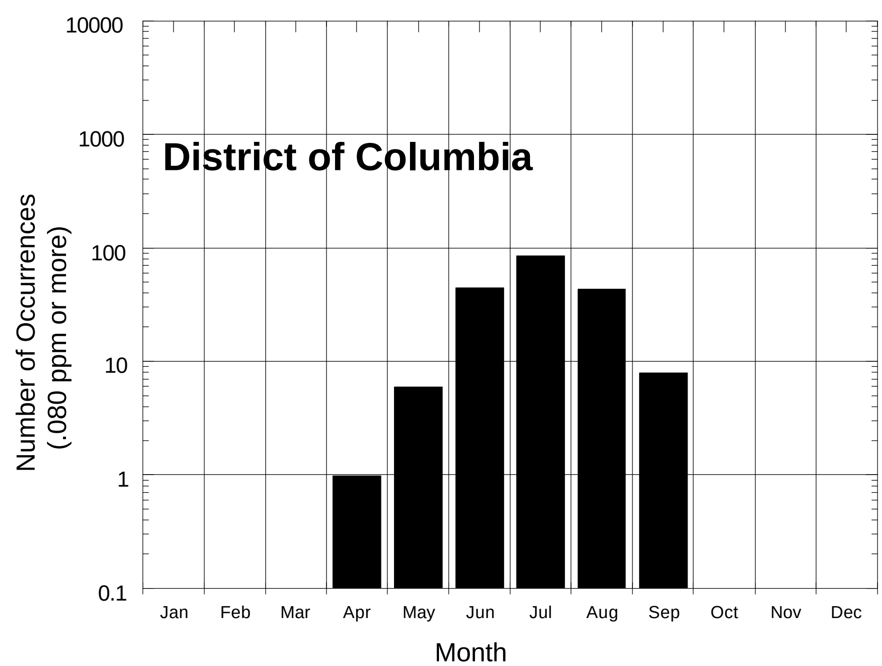
Month


District of Columbia
Number of Occurrences (.080 ppm or more)
10000
1000
100
10
1
0.1
Jan
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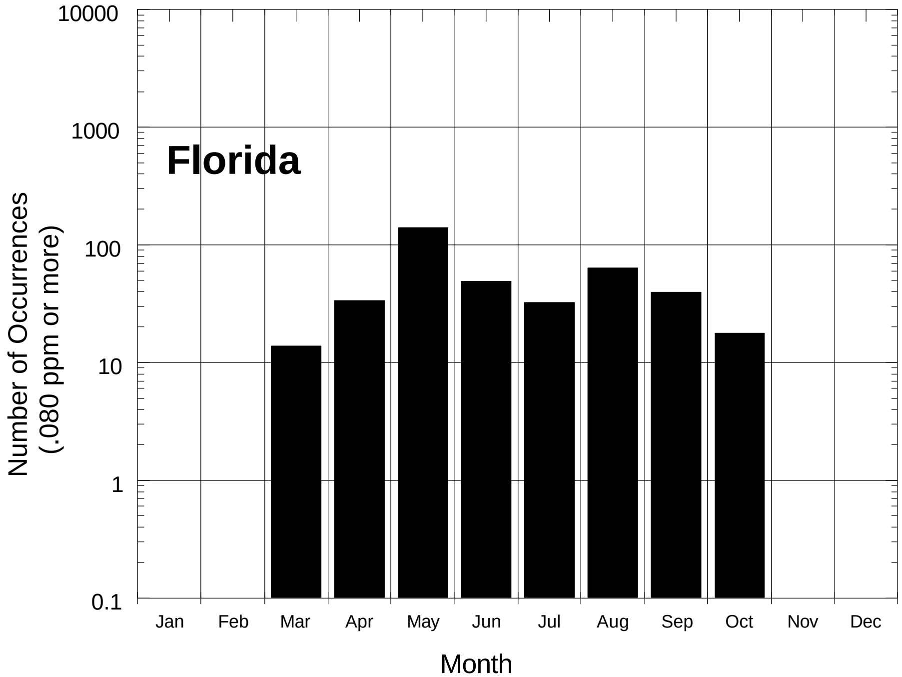
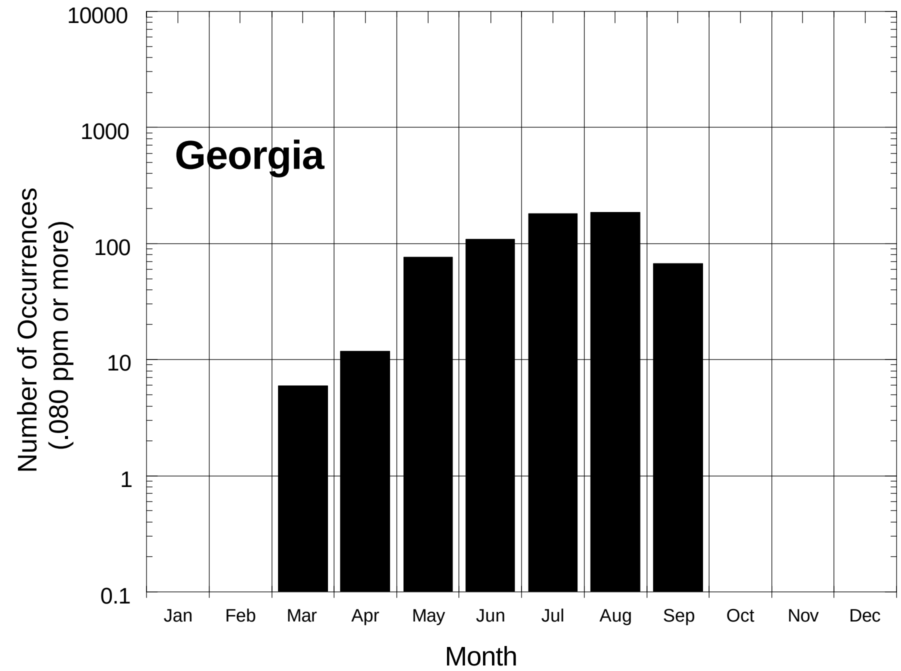
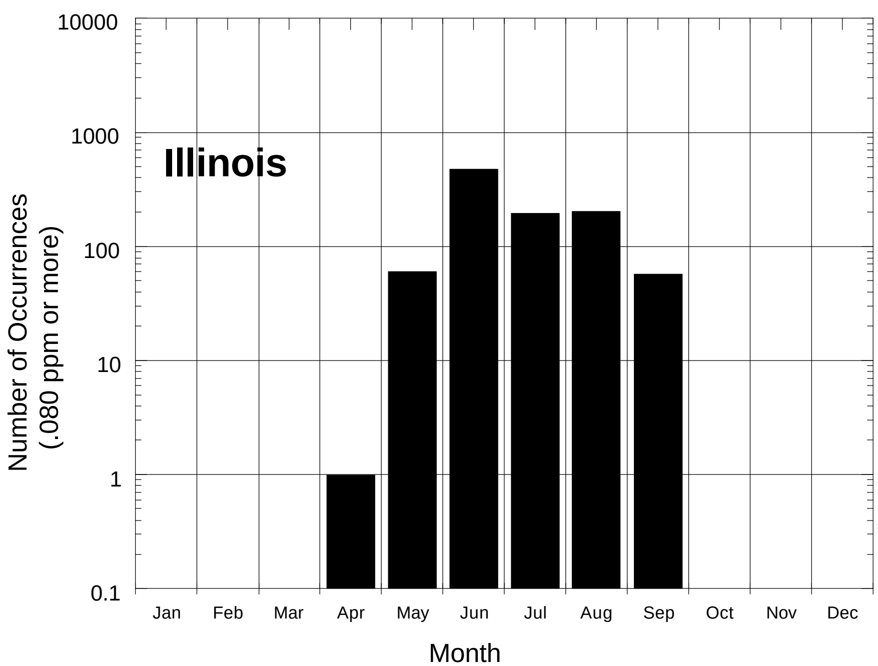
Month



Florida
Number of Occurrences (.080 ppm or more)
10000
1000
100
10
1
0.1
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month



Georgia
Number of Occurrences (.080 ppm or more)
10000
1000
100
10
1
0.1
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month



Illinois
Number of Occurrences (.080 ppm or more)
10000
1000
100
10
1
0.1
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
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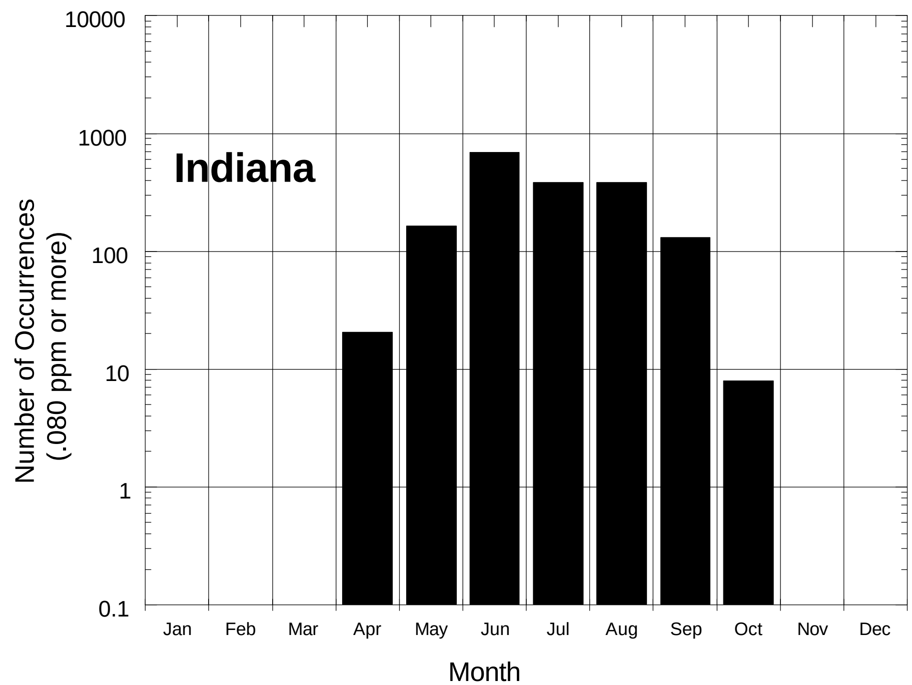

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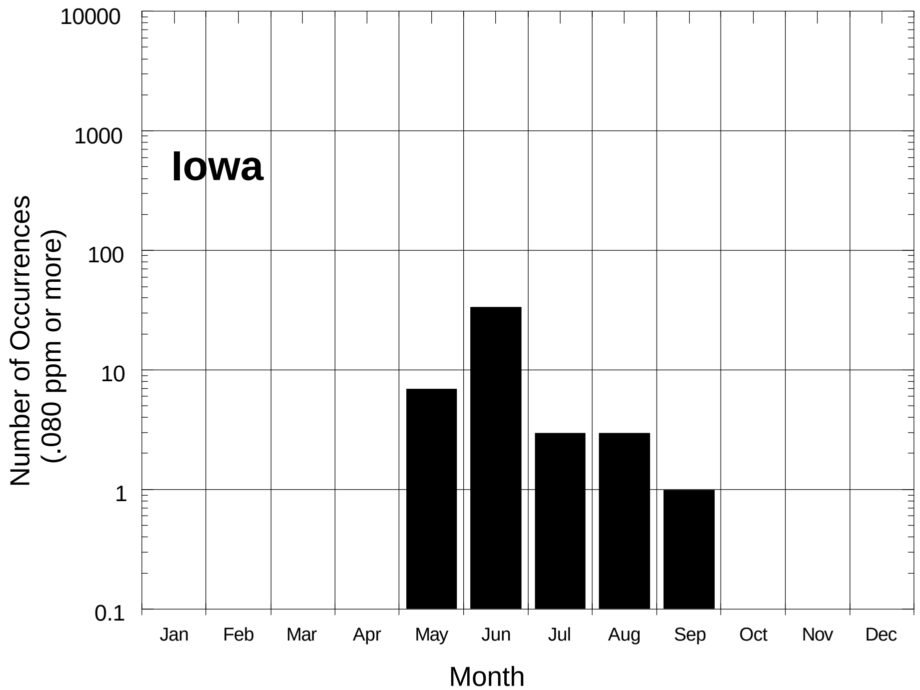
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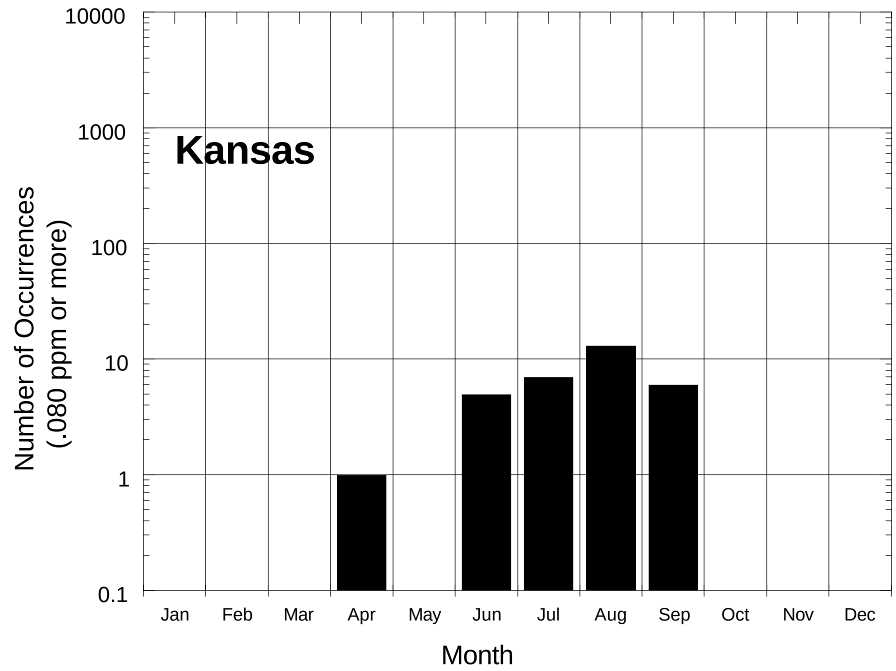
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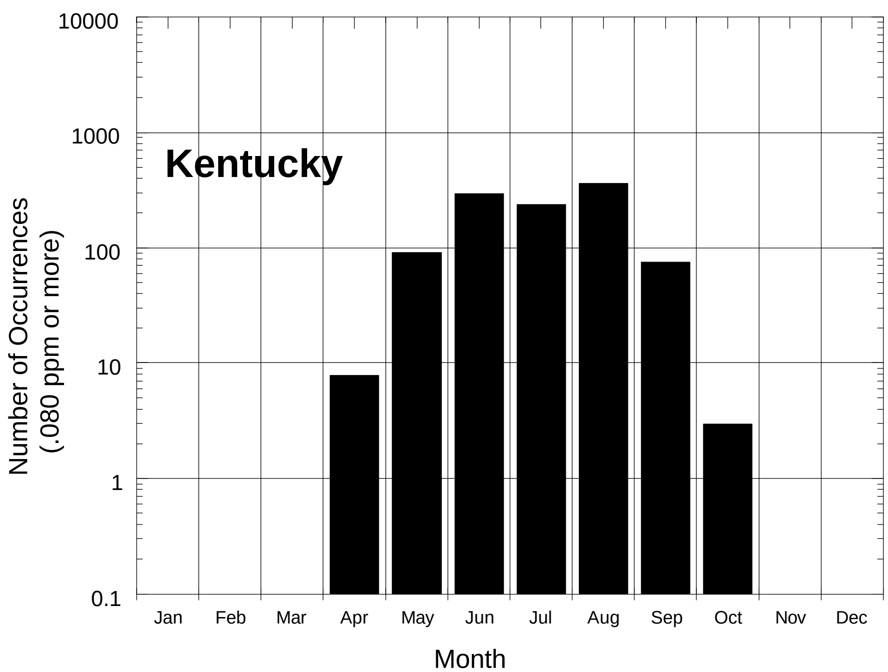
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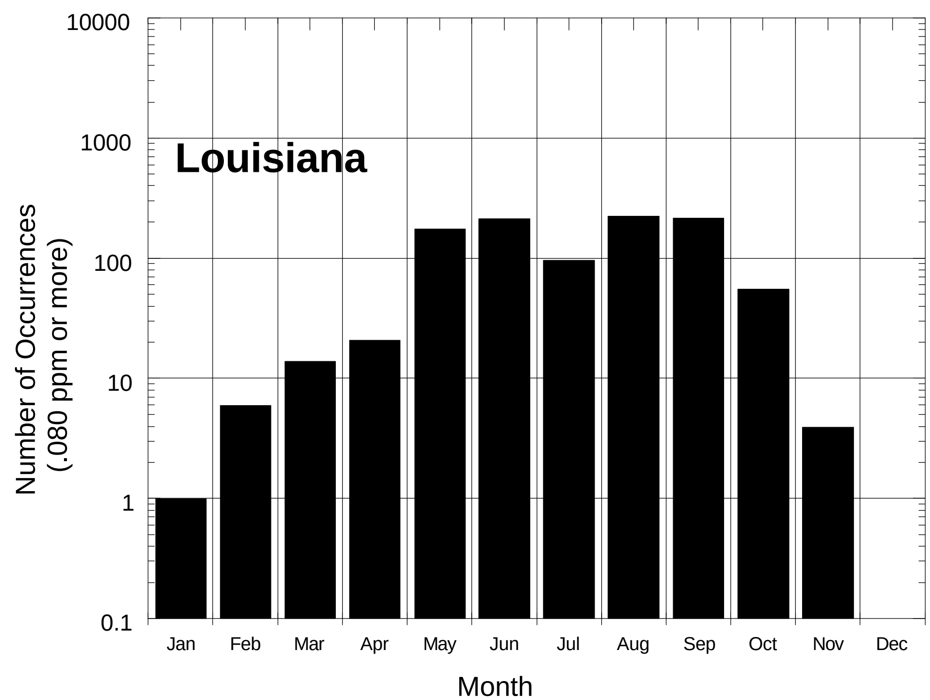
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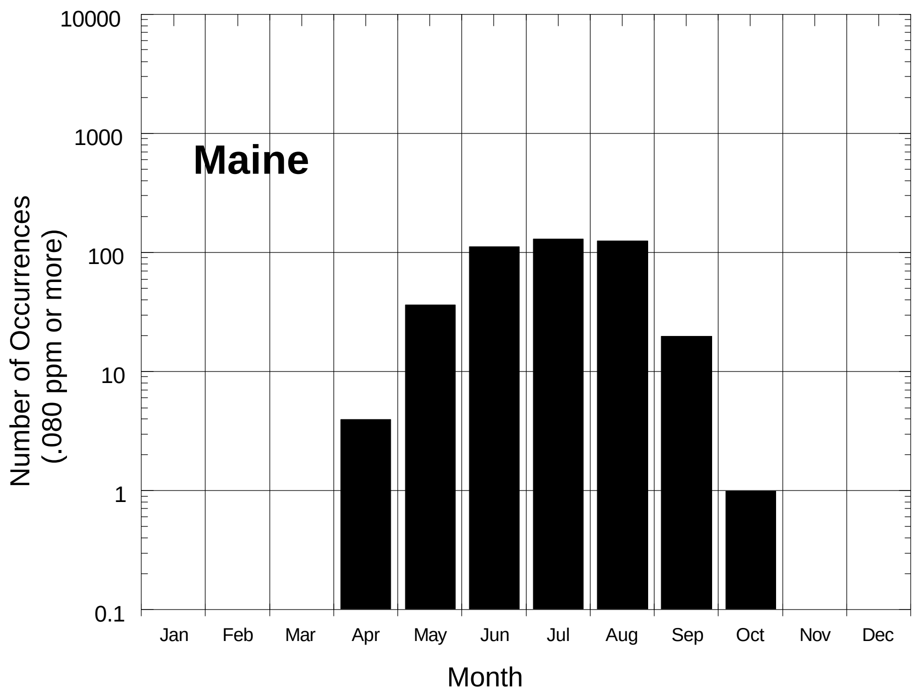
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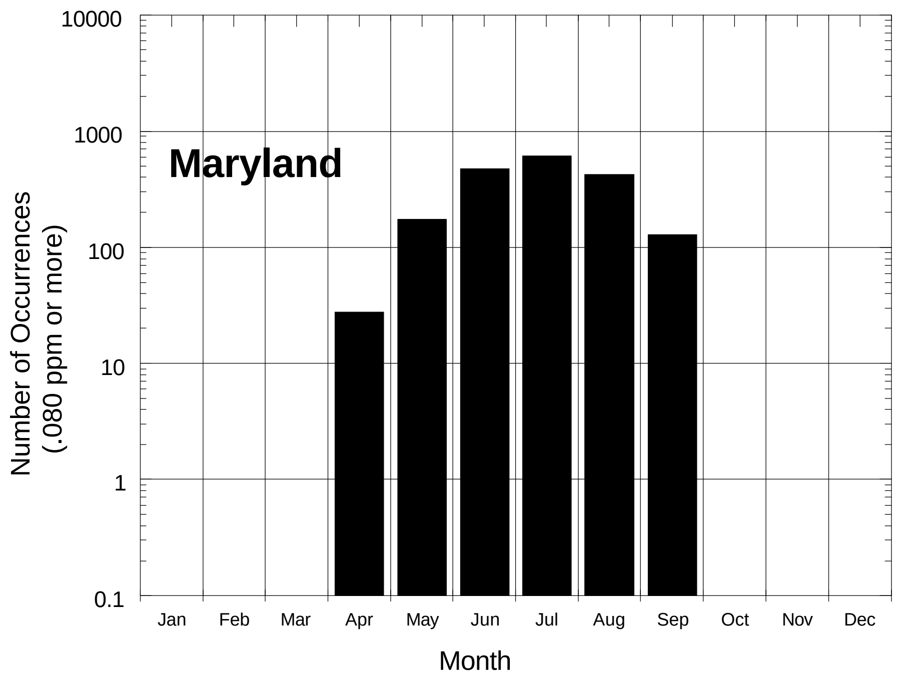
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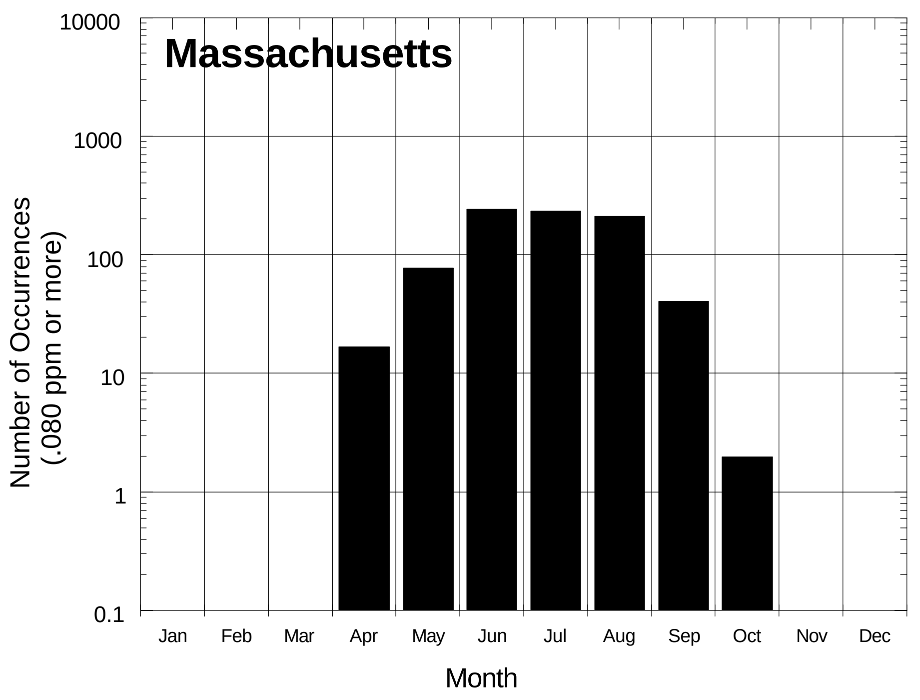
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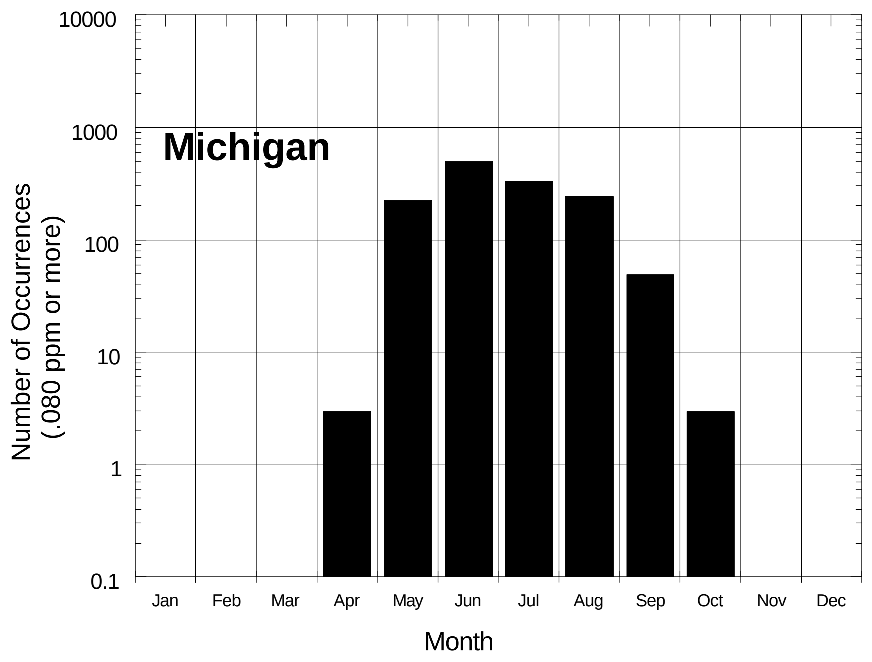
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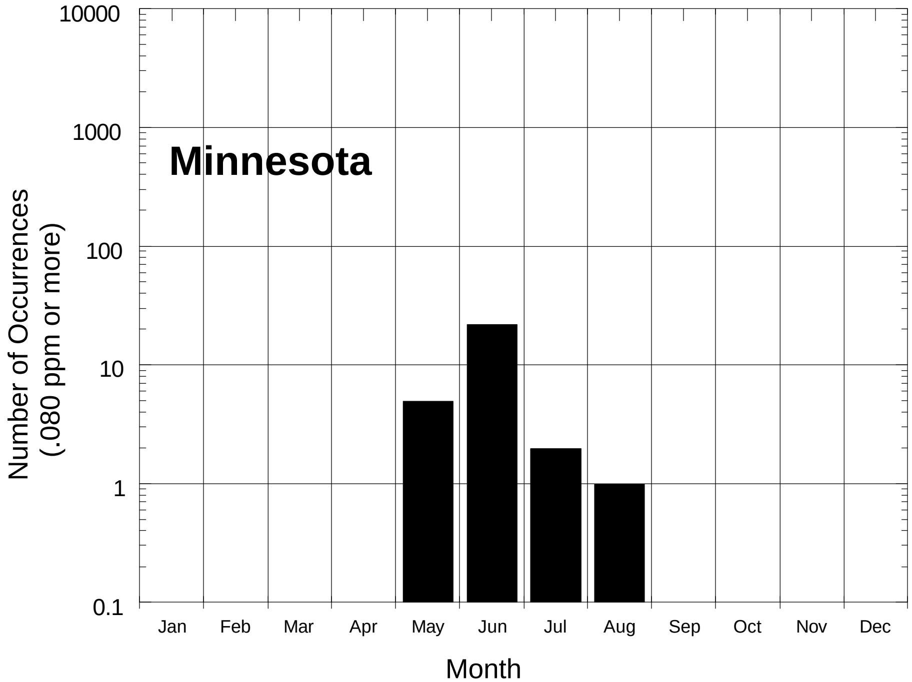
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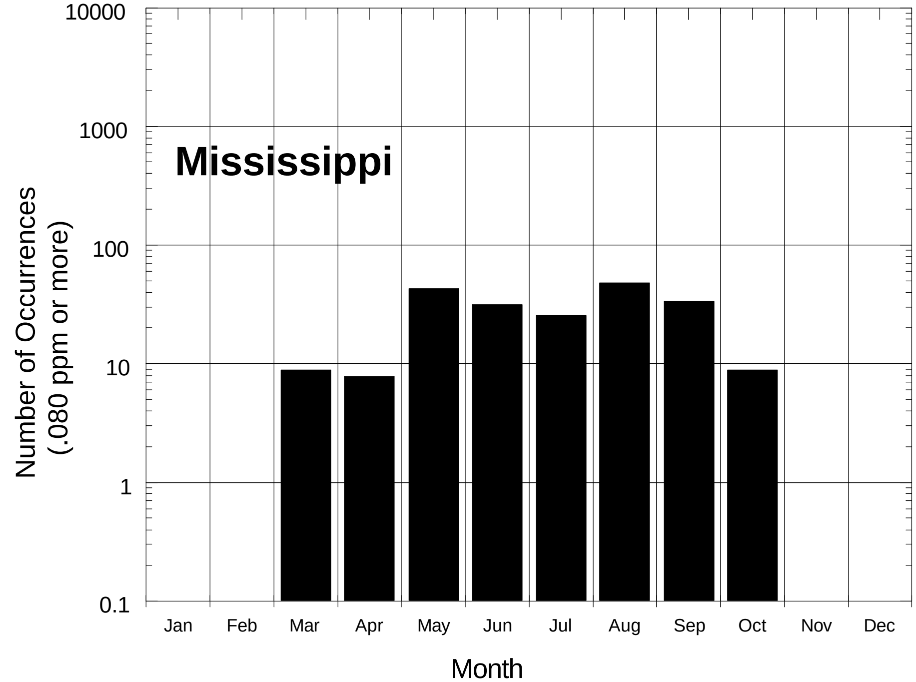
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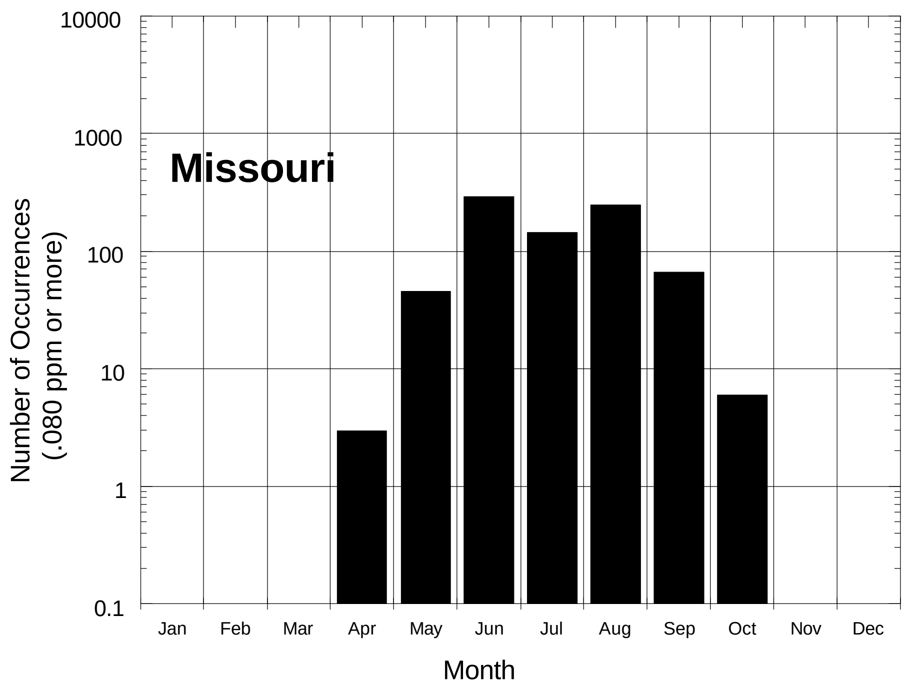
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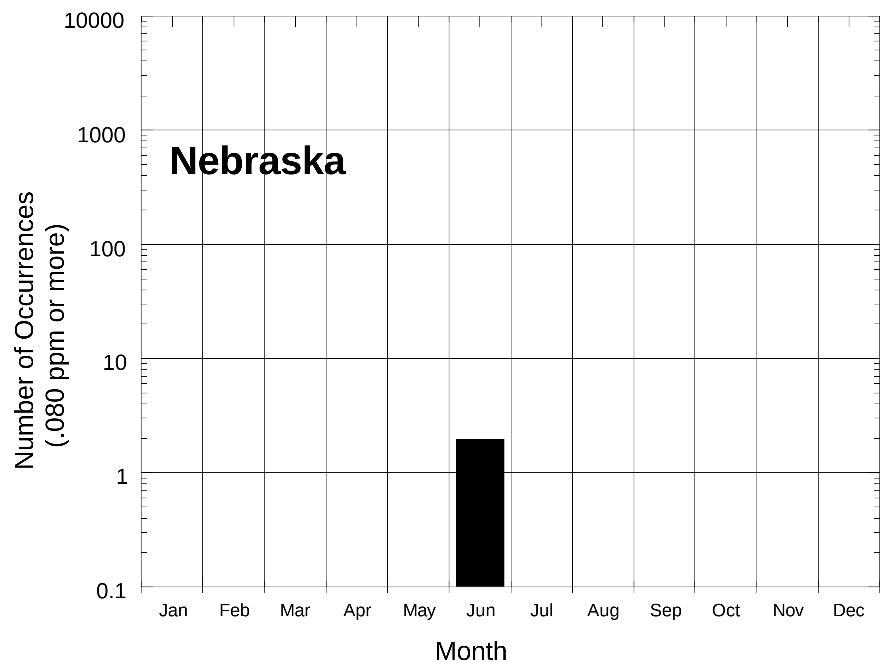
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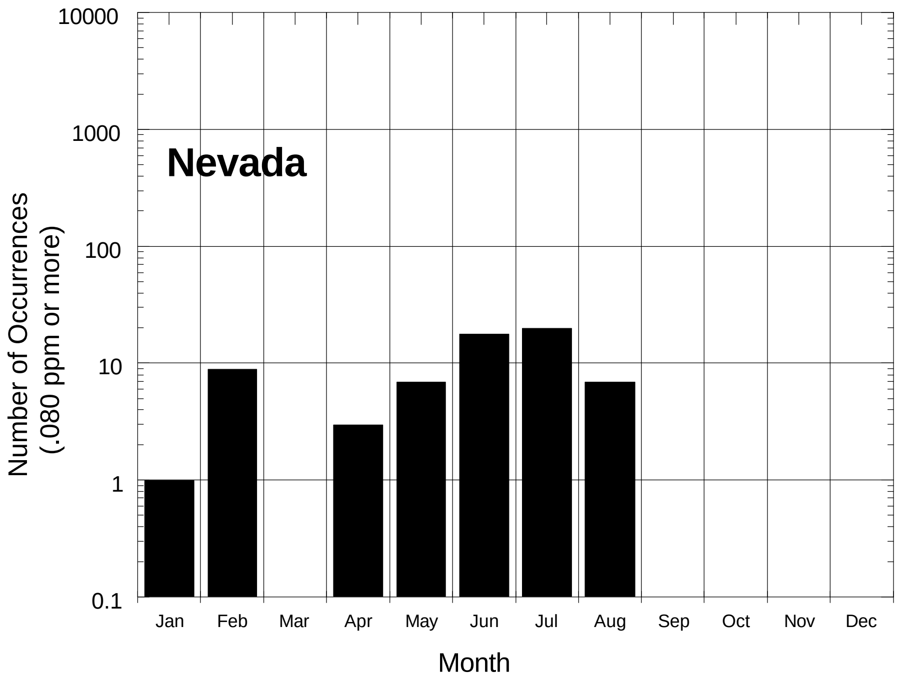
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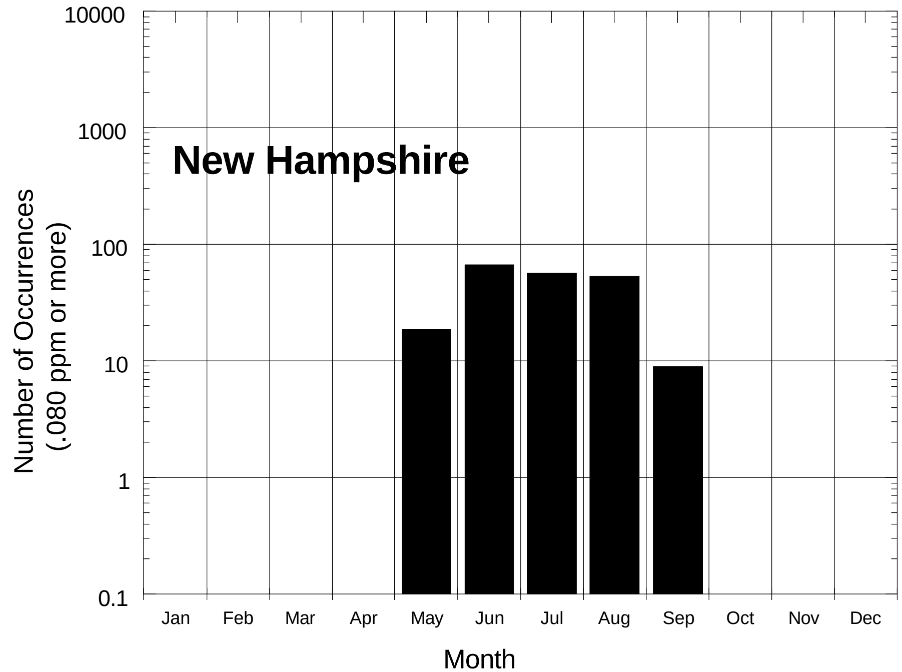
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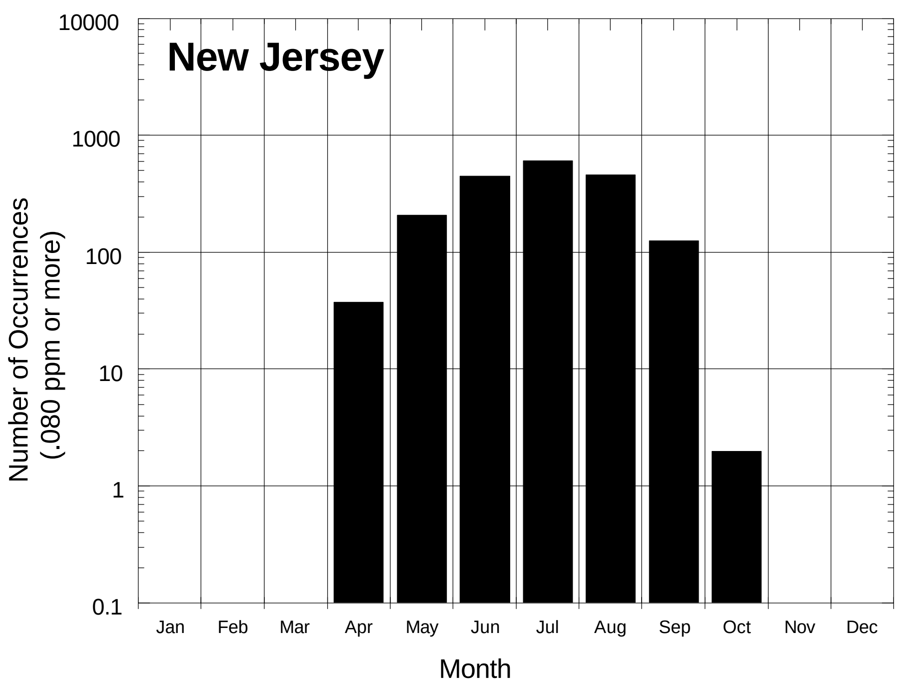
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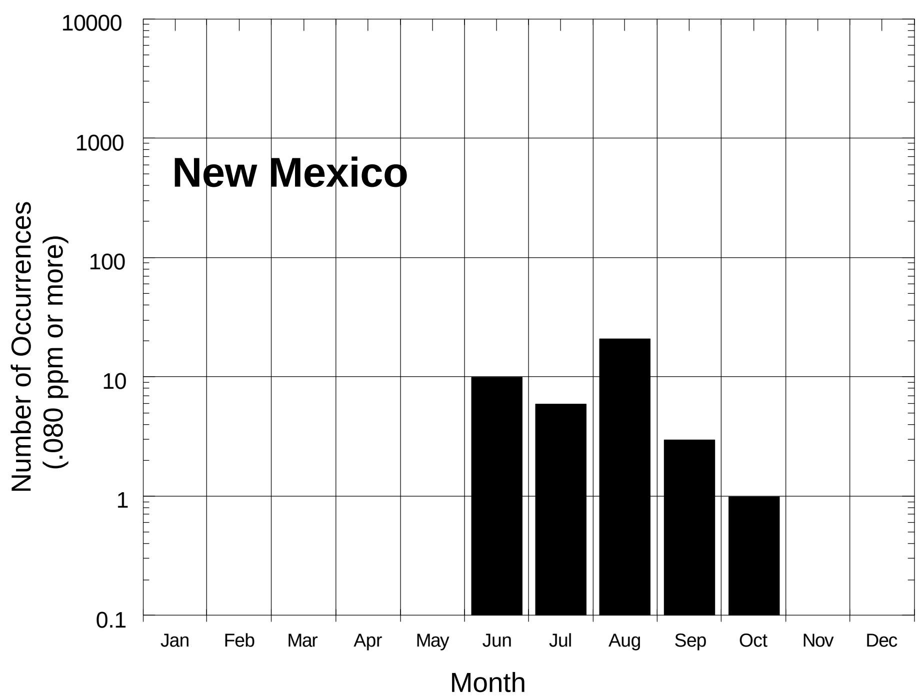
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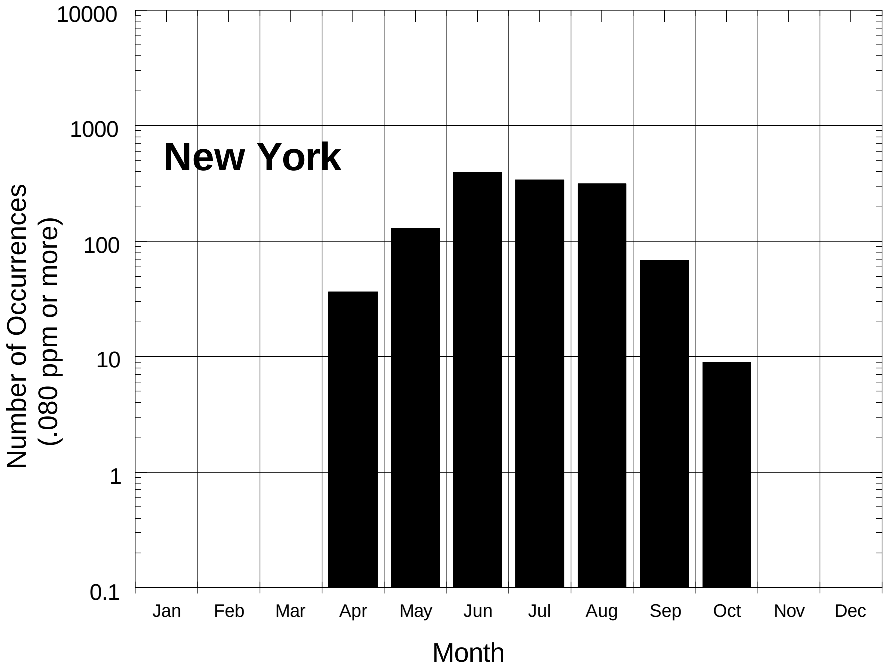
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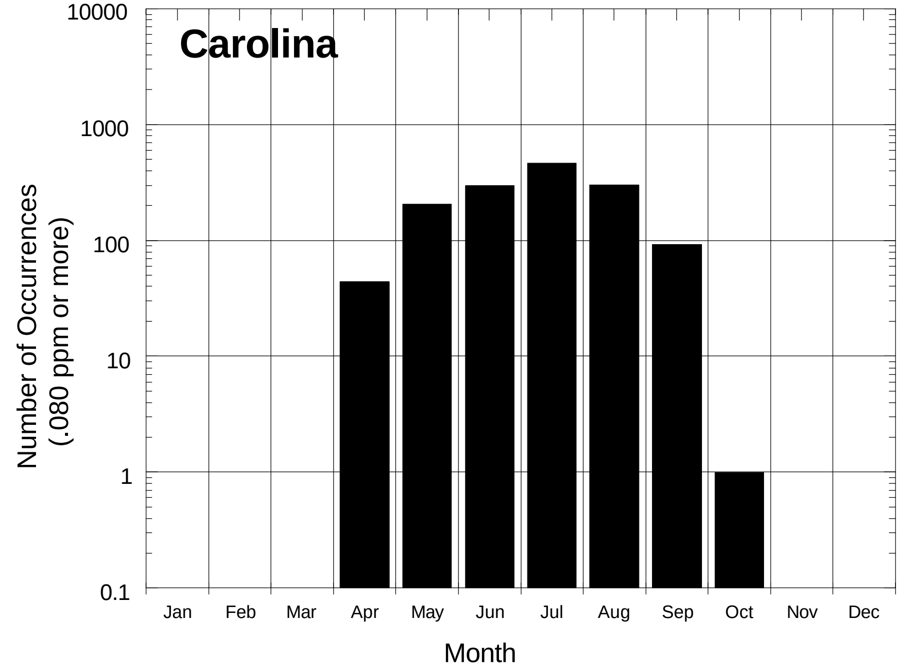
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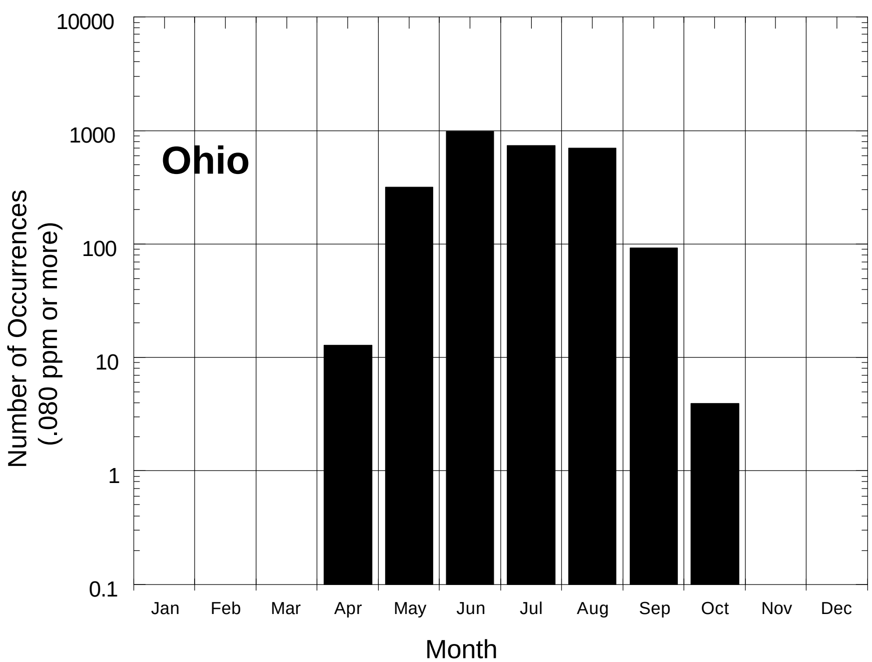
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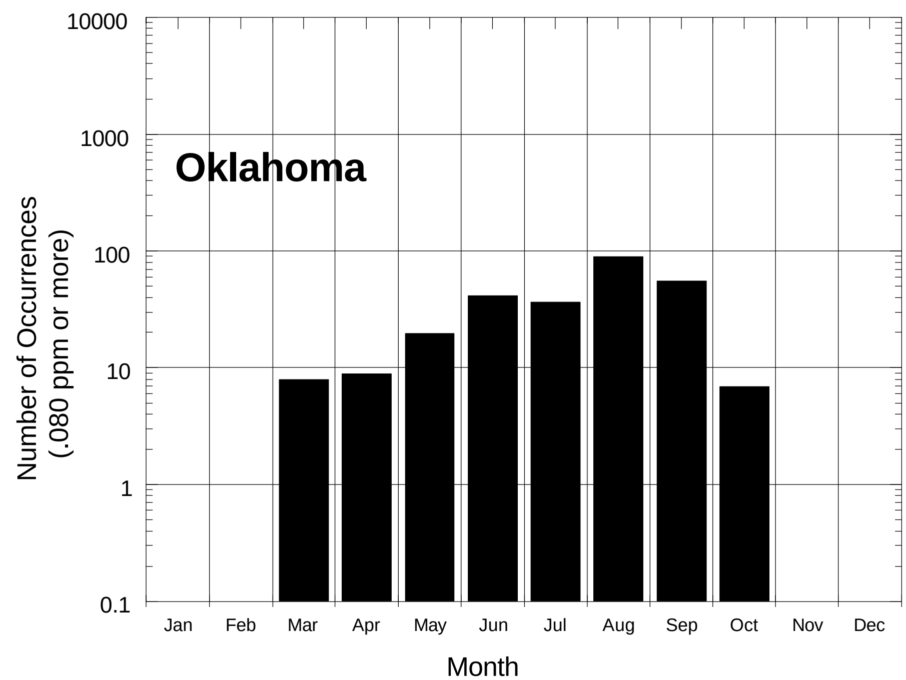
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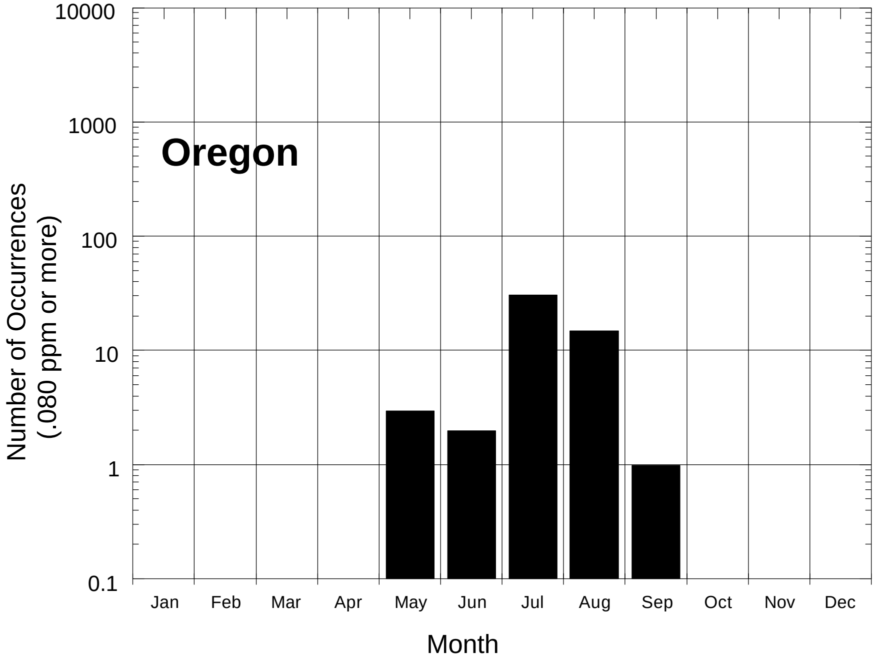
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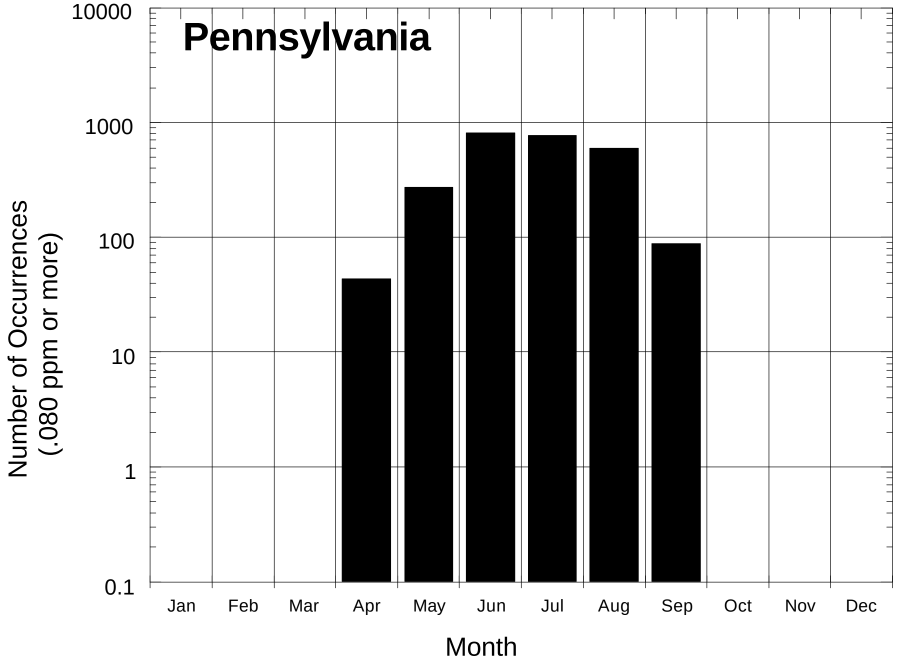
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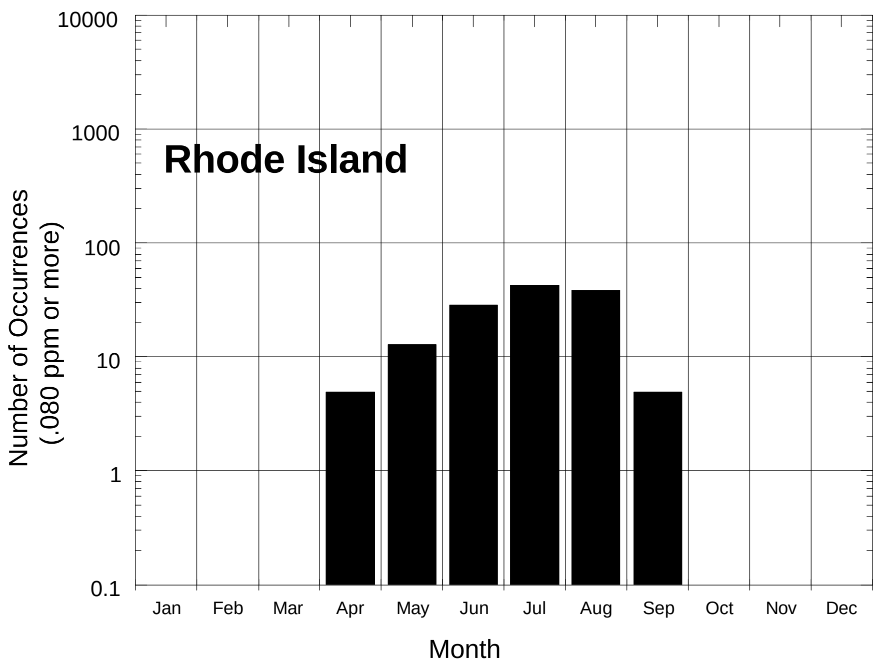
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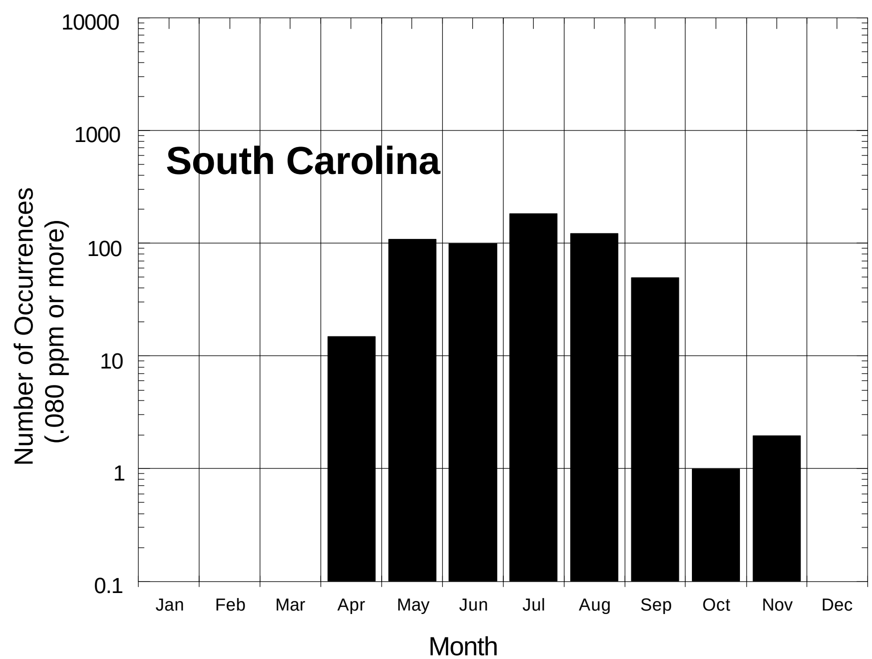
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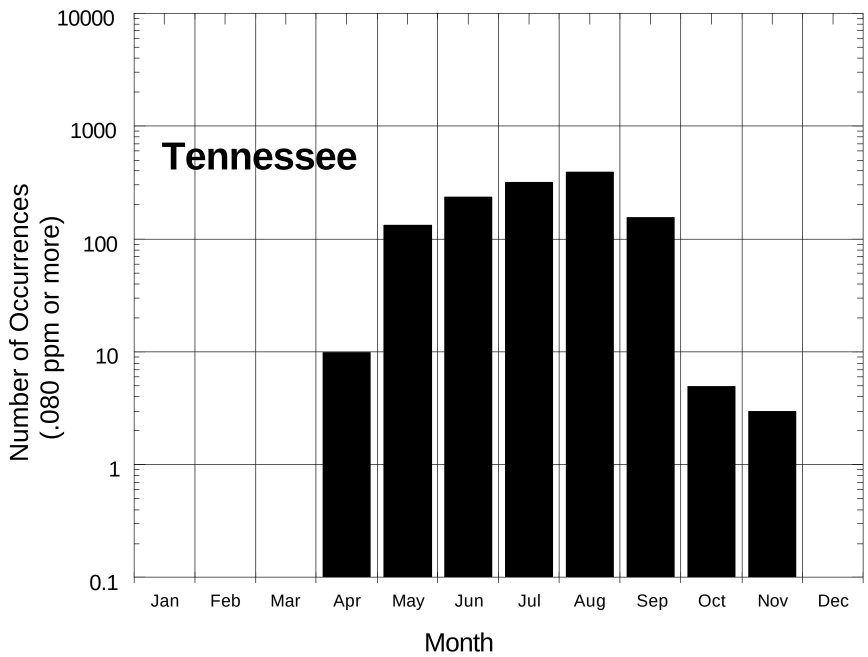
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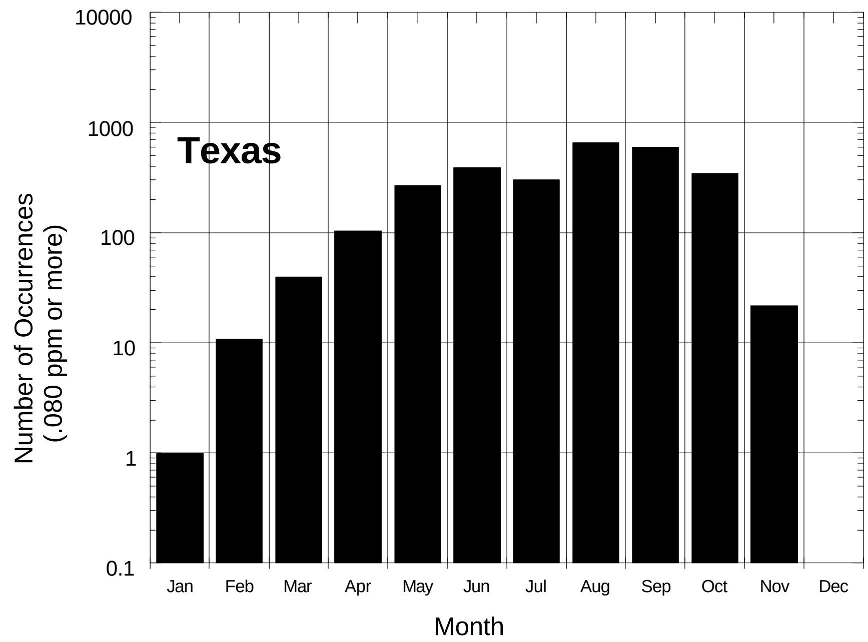
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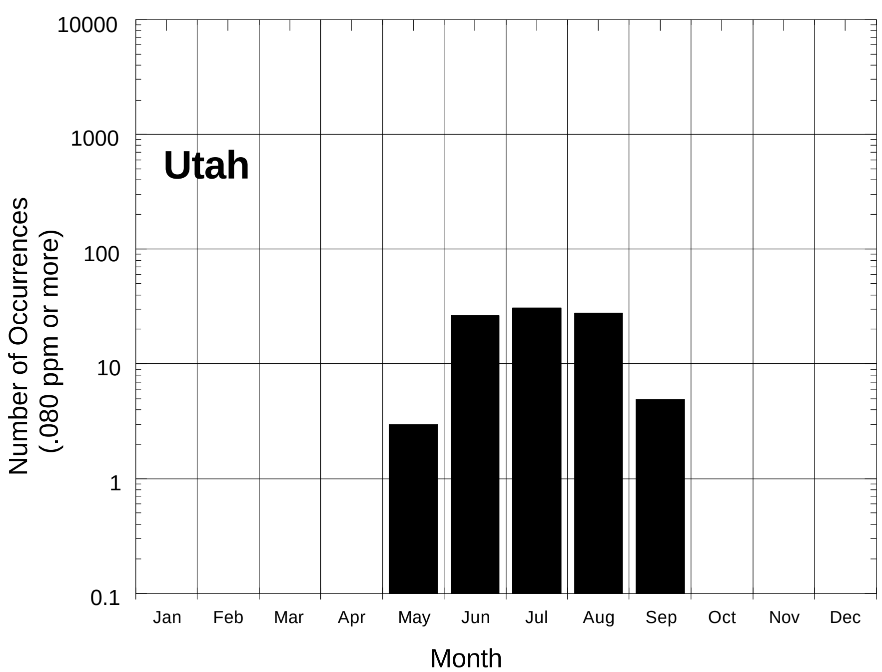
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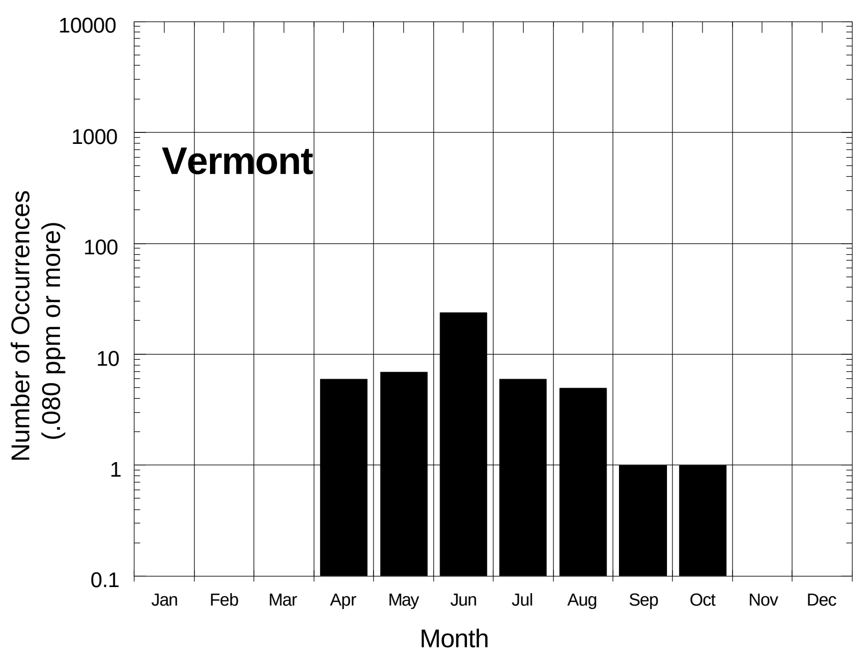
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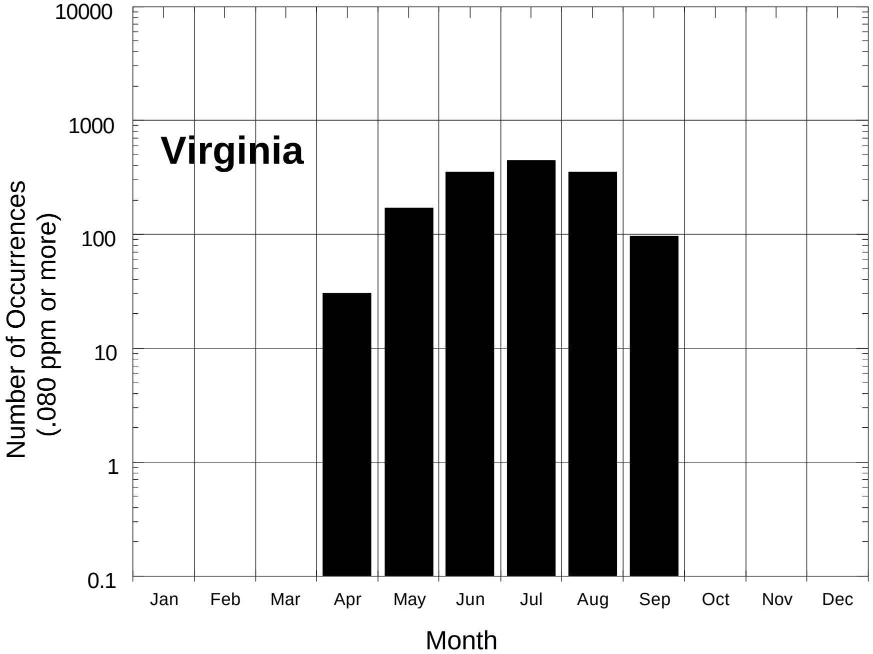
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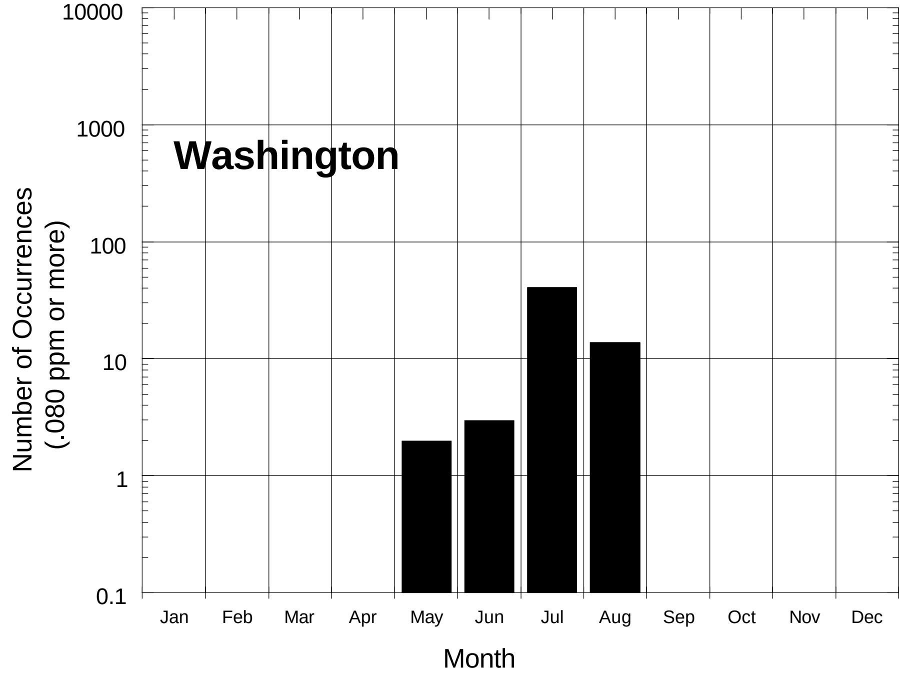
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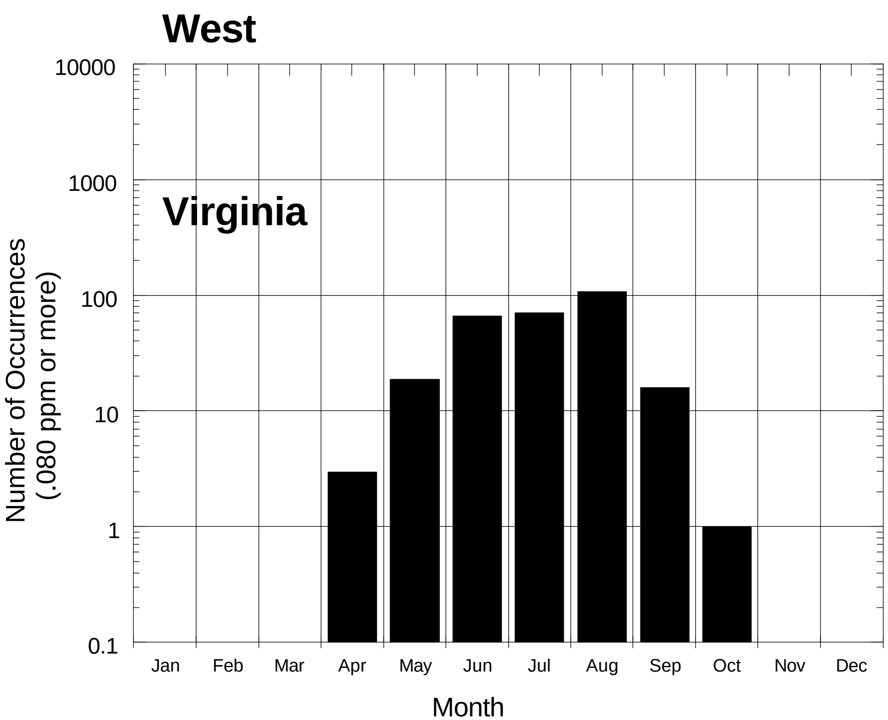
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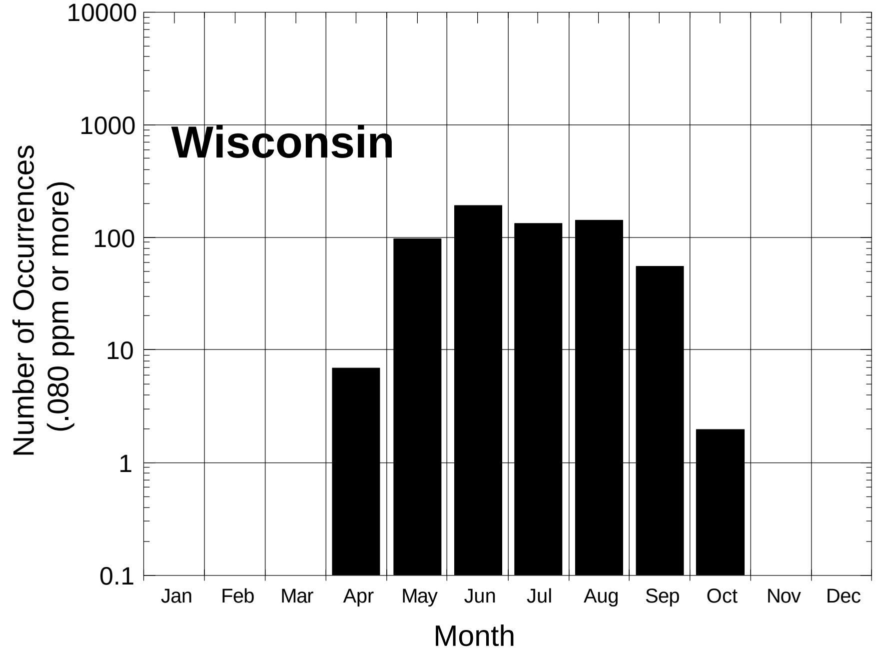
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Appendix B

Calculations

Calculating 24 8-Hour Concentrations

For a given station, the 24 8-hour average ozone concentrations for a given day were calculated in the following manner. The first 8-hour averaged value, μ_1, was calculated using hourly concentrations starting from midnight, C_m,: i.e.,

$$\mu_1 = (C_m + C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7)/8,$$

where m refers to midnight and 1, 2, 3.......refers to 1:00 AM, 2:00 AM, 3:00 AM..... This procedure is repeated until there are 24 8-hour averaged concentrations; i.e.,

$$\mu_2 = (C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_8)/8,$$
$$\mu_3 = (C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_8 + C_9)/8,$$

N

N

$$\mu_{24} = (C_{23} + C_m + C_1 + C_2 + C_3 + C_4 + C_5 + C_6)/8.$$

For 8-hour values calculated for 4:00 p.m.-midnight, the calculations used hourly ozone concentrations that were obtained in the early morning hours of the following day to acquire 24 8-hour averaged concentrations for each day. This method is consistent with the standard data reporting criteria which notes that "8-hour averages are recorded in the start hour...".[7]

[7]40 CFR 50, Appendix I

Appendix C

National Ambient Air Quality Standards for Ozone

40 CFR Part 50

National Ambient Air Quality Standards for Ozone

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: This document describes EPA's decision to revise the national ambient air quality standards (NAAQS) for ozone based on its review of the available scientific evidence linking exposures to ambient to adverse health and welfare effects at levels allowed by the current standards. The current 1-hour primary standard is replaced by an 8-hour standard at a level of 0.08 parts per million (ppm) with a form based on the 3-year average of the annual fourth-highest daily maximum 8-hour average concentrations measured at each monitor within an area. The new primary standard will provide increased protection to the public, especially children and other at-risk populations, against a wide range of -induced health effects, including decreased lung function, primarily in children active outdoors; increased respiratory symptoms, particularly in highly sensitive individuals; hospital admissions and emergency room visits for respiratory causes, among children and adults with pre-existing respiratory disease such as asthma; inflammation of the lung, and possible long-term damage to the lungs. The current 1-hour secondary standard is replaced by an 8-hour standard identical to the new primary standard. The new secondary standard will provide increased protection to the public welfare against -induced effects on vegetation, such as agricultural crop loss, damage to forests and ecosystems, and visible foliar injury to sensitive species.

EFFECTIVE DATE: This rule is effective September 16, 1997.

PART 50--NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS
(Revised in 62FR3855, July 18, 1997)

The revised Section 50.9 follows:

Sec. 50.9 - **National 1-hour Primary and Secondary Ambient Air Quality Standards for Ozone.**

(a) The level of the national 1-hour primary and secondary ambient air quality standards for ozone measured by a reference method based on Appendix D to this part and designated in accordance with Part 53 of this chapter, is 0.12 parts per million (235 g/m^3). The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 parts per million (235 g/m^3) is equal to or less than 1, as determined by Appendix H to this part.

(b) The 1-hour standards set forth in this section will no longer apply to an area once EPA determines that the area has air quality meeting the 1-hour standard. Area designations are codified in 40 CFR part 81.

Section 50.10 was added to read as follows:

Sec. 50.10 - **National 8-hour Primary and Secondary Ambient Air Quality Standards for Ozone.**

(a) The level of the national 8-hour primary and secondary ambient air quality standards for ozone, measured by a reference method based on Appendix D to this part and designated in accordance with Part 53 of this chapter, is 0.08 parts per million (ppm), daily maximum 8-hour average.

(b) The 8-hour primary and secondary ozone ambient air quality standards are met at an ambient air quality monitoring site when the average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.08 ppm, as determined in accordance with Appendix I to this part.

Appendix I was added as follows:

Appendix I to Part 50 - Interpretation of the 8-Hour Primary and Secondary National Ambient Air Quality Standards for Ozone

1. General.

This appendix explains the data handling conventions and computations necessary for determining whether the national 8-hour primary and secondary ambient air quality standards for ozone specified in Sec. 50.10 are met at an ambient ozone air quality monitoring site. Ozone is measured in the ambient air by a reference method based on Appendix D of this part. Data reporting, data handling, and computation procedures to be used in making comparisons between reported ozone concentrations and the level of the ozone standard are specified in the following sections. Whether to exclude, retain, or make adjustments to the data affected by stratospheric ozone intrusion or other natural events is subject to the approval of the appropriate Regional Administrator.

2. Primary and Secondary Ambient Air Quality Standards for Ozone.

2.1 Data Reporting and Handling Conventions.

2.1.1 Computing 8-hour Averages.

Hourly average concentrations shall be reported in parts per million (ppm) to the third decimal place, with additional digits to the right being truncated. Running 8-hour averages shall be computed from the hourly ozone concentration data for each hour of the year and the result shall be stored in the first, or start, hour of the 8-hour period. An 8-hour average shall be considered valid if at least 75% of the hourly averages for the 8-hour period are available. In the event that only 6 (or 7) hourly averages are available, the 8-hour average shall be computed on the basis of the hours available using 6 (or 7) as the divisor. (8-hour periods with three or more missing hours shall not be ignored if, after substituting one-half the minimum detectable limit for the missing hourly concentrations, the 8-hour average concentration is greater than the level of the standard.) The computed 8-hour average ozone concentrations shall be reported to three decimal places (the insignificant digits to the right of the third decimal place are truncated, consistent with the data handling procedures for the reported data.)

2.1.2 Daily Maximum 8-hour Average Concentrations.

(a) There are 24 possible running 8-hour average ozone concentrations for each calendar day during the ozone monitoring season. (Ozone monitoring seasons vary by geographic location as designated in Part 58, Appendix D to this chapter.) The daily maximum 8-hour concentration for a given calendar day is the highest of the 24 possible 8-hour average concentrations computed for that day. This process is repeated, yielding a daily maximum 8-hour average ozone concentration for each calendar day with ambient ozone monitoring data. Because the 8-hour averages are recorded in the start hour, the daily maximum 8-hour concentrations from two consecutive days may have some hourly concentrations in common. Generally, overlapping daily maximum 8-hour averages are not likely, except in those non-urban monitoring locations with less pronounced diurnal variation in hourly concentrations.

(b) An ozone monitoring day shall be counted as a valid day if valid 8-hour averages are available for at least 75% of possible hours in the day (i.e., at least 18 of the 24 averages). In the event that less than 75% of the 8-hour averages are available, a day shall also be counted as a valid day if the daily maximum 8-hour average concentration for that day is greater than the level of the ambient standard.

2.2 Primary and Secondary Standard-related Summary Statistic.

The standard-related summary statistic is the annual fourth-highest daily maximum 8-hour ozone concentration, expressed in parts per million, averaged over three years. The 3-year average shall be computed using the three most recent, consecutive calendar years of monitoring data meeting the data completeness requirements described in this appendix. The computed 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations shall be expressed to three decimal places (the remaining digits to the right are truncated.)

2.3 Comparisons with the Primary and Secondary Ozone Standards.

(a) The primary and secondary ozone ambient air quality standards are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.08 ppm. The number of significant figures in the level of the standard dictates the rounding convention for comparing the computed 3-year average annual fourth-highest daily maximum 8-hour average ozone concentration with the level of the standard. The third decimal place of the computed value is rounded, with values equal to or greater than 5 rounding up. Thus, a computed 3-year average ozone concentration of 0.085 ppm is the smallest value that is greater than 0.08 ppm.

(b) This comparison shall be based on three consecutive, complete calendar years of air quality monitoring data. This requirement is met for the three year period at a monitoring site if daily maximum 8-hour average concentrations are available for at least 90%, on average, of the days during the designated ozone monitoring season, with a minimum data completeness in any one year of at least 75% of the designated sampling days. When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less than the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the appropriate Regional Administrator.

(c) Years with concentrations greater than the level of the standard shall not be ignored on the ground that they have less than complete data. Thus, in computing the 3-year average fourth maximum concentration, calendar years with less than 75% data completeness shall be included in the computation if the average annual fourth maximum 8-hour concentration is greater than the level of the standard.

(d) Comparisons with the primary and secondary ozone standards are demonstrated by Examples 1 and 2 in paragraphs (d)(1) and (d) (2) respectively as follows:

(1) As shown in Example 1, the primary and secondary standards are met at this monitoring site because the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations (i.e., 0.084 ppm) is less than or equal to 0.08 ppm. The data completeness requirement is also met because the average percent of days with valid ambient monitoring data is greater than 90%, and no single year has less than 75% data completeness.

Example 1. Ambient Monitoring Site Attaining the Primary and Secondary Ozone Standards

Year	Percent Valid Days	1st Highest Daily Max 8-Hour Conc. (ppm)	2nd Highest Daily Max 8-Hour Conc. (ppm)	3rd Highest Daily Max 8-Hour Conc. (ppm)	4th Highest Daily Max 8-Hour Conc. (ppm)	5th Highest Daily Max 8-Hour Conc. (ppm)
1993	100%	0.092	0.091	0.090	0.088	0.085
1994	96%	0.090	0.089	0.086	0.084	0.080
1995	98%	0.087	0.085	0.083	0.080	0.075
Average	98%				0.084	

(2) As shown in Example 2, the primary and secondary standards are not met at this monitoring site because the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations (i.e., 0.093 ppm) is greater than 0.08 ppm. Note that the ozone concentration data for 1994 is used in these computations, even though the data capture is less than 75%, because the average fourth-highest daily maximum 8-hour average concentration is greater than 0.08 ppm.

Example 2. Ambient Monitoring Site Failing to Meet the Primary and Secondary Ozone Standards

Year	Percent Valid Days	1st Highest Daily Max 8-Hour Conc. (ppm)	2nd Highest Daily Max 8-Hour Conc. (ppm)	3rd Highest Daily Max 8-Hour Conc. (ppm)	4th Highest Daily Max 8-Hour Conc. (ppm)	5th Highest Daily Max 8-Hour Conc. (ppm)
1993	96%	0.105	0.103	0.103	0.102	0.102
1994	74%	0.090	0.085	0.082	0.080	0.078
1995	98%	0.103	0.101	0.101	0.097	0.095
Average	89%				0.093	

3. Design Values for Primary and Secondary Ambient Air Quality Standards for Ozone.

The air quality design value at a monitoring site is defined as that concentration that when reduced to the level of the standard ensures that the site meets the standard. For a concentration-based standard, the air quality design value is simply the standard-related test statistic. Thus, for the primary and secondary ozone standards, the 3-year average annual fourth-highest daily maximum 8-hour average ozone concentration is also the air quality design value for the site.