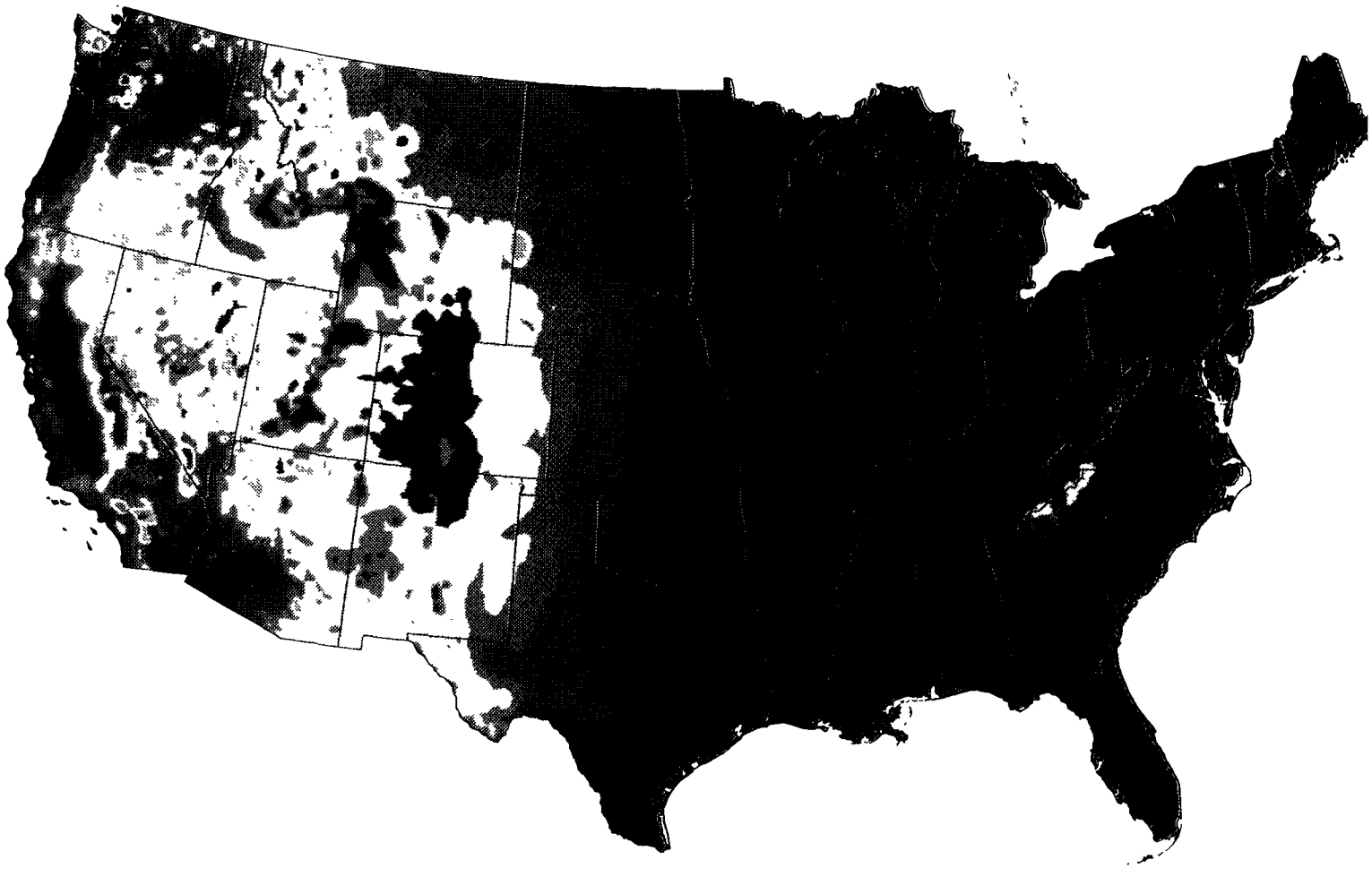
United States Environmental Protection Agency
Office of Air Quality Planning and Standards Research Triangle Park NC 27711
400-K-92-002 May 1992
Air

EPA *Air Quality Atlas*



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Air Quality Atlas

U.S. ENVIRONMENTAL PROTECTION AGENCY

Office of Air and Radiation
Office of Air Quality Planning and Standards
Technical Support Division
Research Triangle Park, North Carolina 27711

May 1992

For More Information on Air Quality: This atlas was prepared by the Technical Support Division of the U.S. Environmental Protection Agency. The Division also prepares an annual report entitled *National Air Quality and Emissions Trends Report* which is directed toward both the technical air pollution audience and the interested general public. Copies of these reports may be obtained from the Data Analysis Section (MD-14), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

About the Cover: The cover map displays the topographical features of the contiguous United States. Topography can affect air quality by trapping air pollutants in valleys, by channelling wind flows, and by its secondary effects on precipitation. Data Source: Defense Mapping Agency

Introduction

A picture truly is worth a thousand words. The eye can assimilate and process a vast amount of information at one time, quickly discerning important characteristics through direct visual comparisons of relationships among areas. This atlas presents maps that show the nation's air quality monitoring network and how air quality varies across the country. Some of the maps have been included in other EPA publications; others are appearing here for the first time.

Most air pollution comes from human activities such as factories, power plants, commercial and residential sources, and cars, buses, and other transportation sources. The Clean Air Act provides the framework for EPA, state, and local efforts to protect air quality by controlling emissions from these activities. Air pollution can also result from natural sources such as forest fires and active volcanos.

Because the number and type of pollution sources vary from one place to another, air quality also varies geographically. Meteorological and topographical factors also affect air quality by reducing the cleansing ability of the atmosphere. Air inversions, for example, are common in many areas of the country (especially in the fall and winter). They trap pollution in a relatively shallow layer near the ground. Stagnating high-pressure systems in the summer can also cause deteriorated air quality. Urban areas located in valleys can have air quality problems when pollutants get trapped and accumulate over time. (See the cover for a U.S. topographical map.) All of these factors, in the presence of pollution sources, can contribute to the spatial variation in air quality seen on the maps in this atlas.

Some of the maps display the extent and coverage of the air quality monitoring network in the United States. Other maps identify areas in which measured air quality levels did not meet the current National Ambient Air Quality Standards (NAAQS) in 1990, as well as areas that experienced good air quality, i.e., levels significantly below the NAAQS. This atlas focuses on air concentrations that are direct measurements of pollutant concentrations at monitoring sites throughout the country. Pollutant emission values are based on best engineering estimates of the total tonnage of these pollutants released into the air annually.

Some Perspective

When focusing on current air quality status, it is important not to overlook some of the earlier efforts in air pollution control. Emission estimates are useful for examining long-term trends (see Figure). Between 1970 and 1990, lead emissions clearly show the most impressive decrease (–97 percent), but there were also improvements in emissions of total particulate (–59 percent), sulfur oxides (–25 percent), carbon monoxide (–41 percent), and volatile organic compounds (–31 percent). Volatile organic compounds and nitrogen oxides are ozone precursors. Only emissions of nitrogen oxides showed an increase (+6 percent). It is important to realize that the reductions occurred even in the face of economic growth.

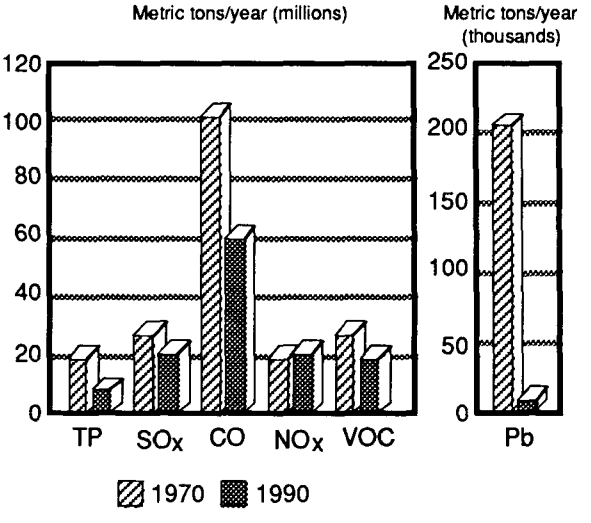
National Ambient Air Quality Standards (NAAQS)

In this atlas, the measures of air quality displayed for a particular pollutant are directly related to the National Ambient Air Quality Standard (NAAQS) for that pollutant; the term "air quality standard" in this atlas refers to these NAAQS. Air quality standards are currently in place for six pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter with aerodynamic size less than or equal to 10 microns (PM-10) and sulfur dioxide (SO_2) (see Table). A micron is equal to a millionth of a meter.

Carbon monoxide is a colorless, odorless, poisonous gas that is a product of incomplete fuel combustion. The main source of CO in cities is motor vehicle exhaust; other sources are wood-burning stoves, incinerators, and industrial processes.

Lead emissions to the atmosphere come primarily from non-ferrous smelters, battery plants, and lead additives in gasoline. A major environmental success story is the dramatic reduction of lead in the air caused by the lowering of lead levels in gasoline

Comparison of 1970 and 1990 Emissions



and, beginning in 1975, the required use of unleaded gasoline in cars.

Nitrogen dioxide is a poisonous, brownish gas that is a precursor to ozone and to acidic precipitation. The major sources of nitrogen oxides emissions are motor vehicles and fuel combustion sources such as electric utilities and industrial boilers.

Ozone, unlike the other five pollutants, is not emitted directly into the air, but is created by sunlight acting on the precursor pollutants nitrogen oxides and volatile organic compounds. The sources of these precursors are diverse. They include gasoline vapors, chemical solvents, fuel combustion products, and even consumer products. Because ozone levels are influenced in part by meteorological conditions, such as hot weather, recent year-to-year ozone trends have been more variable than trends for other pollutants.

The discussions of ozone in this atlas refer to ground-level, or *tropospheric*, ozone and not to *stratospheric* ozone. Ozone in the stratosphere, miles above the earth, is a beneficial screen from the sun's ultraviolet rays. Ozone at ground level, in the air we breathe, is a health and environmental concern, and is the primary ingredient of what is commonly called *smog*.

National Ambient Air Quality Standards (NAAQS) In Effect In 1992

POLLUTANT	PRIMARY (HEALTH RELATED)		SECONDARY (WELFARE RELATED)	
	Type of Average	Standard Level Concentration[a]	Type of Average	Standard Level Concentration[a]
CO	8-hour[b]	9 ppm (10 μg/m^3)	No Secondary Standard	
	1-hour[b]	35 ppm (40 μg/m^3)	No Secondary Standard	
NO_2	Annual Arithmetic Mean	0.053 ppm (100 μg/m^3)	Same as Primary Standard	
O_3	Maximum Daily 1-hour Average[c]	0.12 ppm (235 μg/m^3)	Same as Primary Standard	
Pb	Maximum Quarterly Average	1.5 μg/m^3	Same as Primary Standard	
PM-10	Annual Arithmetic Mean[d]	50 μg/m^3	Same as Primary Standard	
	24-hour[d]	150 μg/m^3	Same as Primary Standard	
SO_2	Annual Arithmetic Mean	80 μg/m^3 (0.03 ppm)	3-hour[b]	1300 μg/m^3 (0.50 ppm)
	24-hour[b]	365 μg/m^3		

a Parenthetical value is an approximately equivalent concentration.

b Not to be exceeded more than once per year.

c The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than 1, as determined according to Appendix H of the Ozone NAAQS.

d Particulate standards use PM-10 (particles less than 10μ in diameter) as the indicator pollutant. The annual standard is attained when the expected annual arithmetic mean concentration is less than or equal to 50 μg/m^3; the 24-hour standard is attained when the expected number of days per calendar year above 150 μg/m^3 is equal to or less than 1; as determined according to Appendix K of the PM NAAQS.

PM-10 may be thought of as dust and soot suspended in the air. Principal PM-10 sources include industrial sources, wood-burning stoves, urban dust, and open burning for forest management and agricultural purposes.

Sulfur dioxide is formed from the burning of sulfur-containing fuel, mainly coal and oil, and also from metal smelting and other industrial processes. It is a major precursor to acidic deposition (acid rain).

There are two types of standards—primary and secondary. Primary standards protect against adverse health effects; secondary standards protect against welfare effects, such as damage to farm crops and vegetation and damage to buildings. Because different pollutants have different effects, the NAAQS are also different. Some pollutants (PM-10 and SO_2) have standards for both long-term (annual) and short-term (24-hour) averaging times. The short-term standards are designed to protect against acute, or short-term, health effects, while the long-term standards were established to protect against chronic health effects.

Air Quality Monitoring

State and local government monitoring stations across the nation collect direct measurements of pollutant concentrations. Air quality data are submitted to EPA's Aerometric Information Retrieval System (AIRS) by State and local governments and various federal agencies. The vast majority of these measurements represent the country's heavily populated urban areas.

EPA and other federal agencies also operate some air quality monitoring sites on a temporary basis as a part of air pollution research studies.

In 1990, almost 4100 monitoring sites reported air quality data for the six NAAQS pollutants to AIRS (see Table and Figure). The national monitoring network conforms to uniform criteria for monitor siting, instrumentation, and quality assurance.

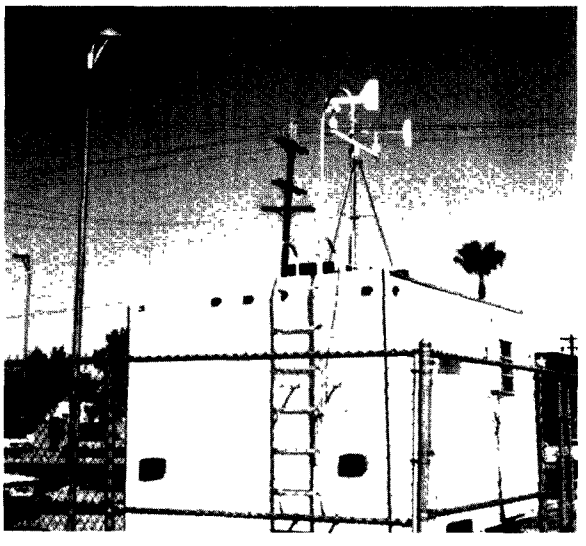
Each monitoring site is classified into one of three categories: NAMS, SLAMS, or SPMS. The NAMS, or National Air Monitoring Stations, were established to ensure a long-term national network for urban-area-oriented ambient monitoring information and to provide a systematic, consistent data base for air quality comparisons and trends analysis. The SLAMS, or State and Local Air Monitoring Stations, were established to allow State or local governments to develop monitoring networks tailored more to their immediate ambient air monitoring needs. The

Number of Monitoring Sites Reporting to AIRS in 1990

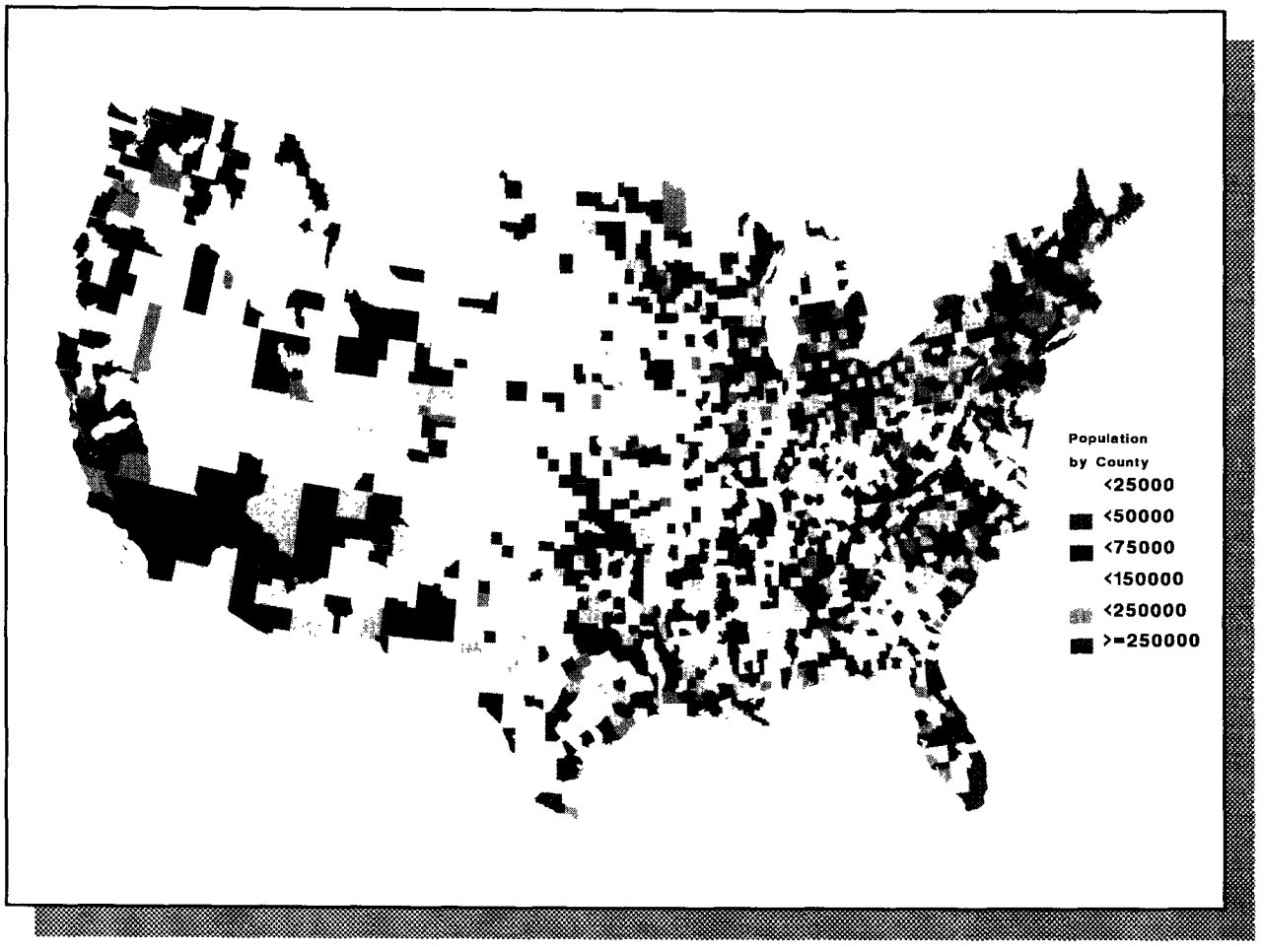
Pollutant	Number of Sites
Carbon Monoxide (CO)	491
Nitrogen Dioxide (NO_2)	330
Ozone (O_3)	812
Lead (Pb)	406
Particulates (PM-10)	1,279
Sulfur Dioxide (SO_2)	741
TOTAL	4,059

SPMS, special purpose monitors, are stations used by State and local agencies to fulfill very specific or short-term monitoring goals. The type of each monitoring site is identified on the individual pollutant monitoring network maps.

Most of the air quality information in this atlas is based on two indicators: actual measurements of pollutants in the ambient air, and the number of times that the levels of the air quality standards were exceeded. The Pollutant Standards Index (PSI) is also used to show how air quality varies across the United States. The PSI is a uniform air quality index developed for the daily reporting of air pollution concentrations in most major U.S. cities. A standard color sequence is employed when this air pollution information is reported to the public. The PSI colors were selected for all the air quality maps in this atlas to provide a readily identifiable and consistent color scheme throughout. The "cooler" PSI colors (blue and green) indicate air quality that is "better" than the level of the corresponding air quality standard. The "warmer" PSI colors (yellow, orange, and red) denote air quality levels that do not meet the NAAQS for that pollutant. The air quality maps are complemented by maps that display meteorological, population, and transportation data.

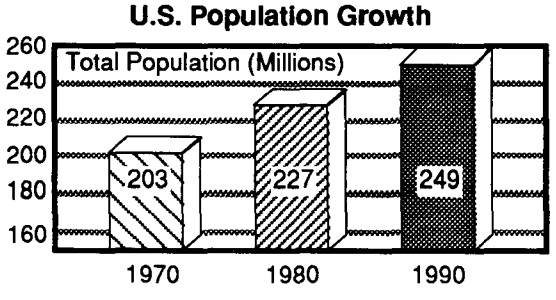


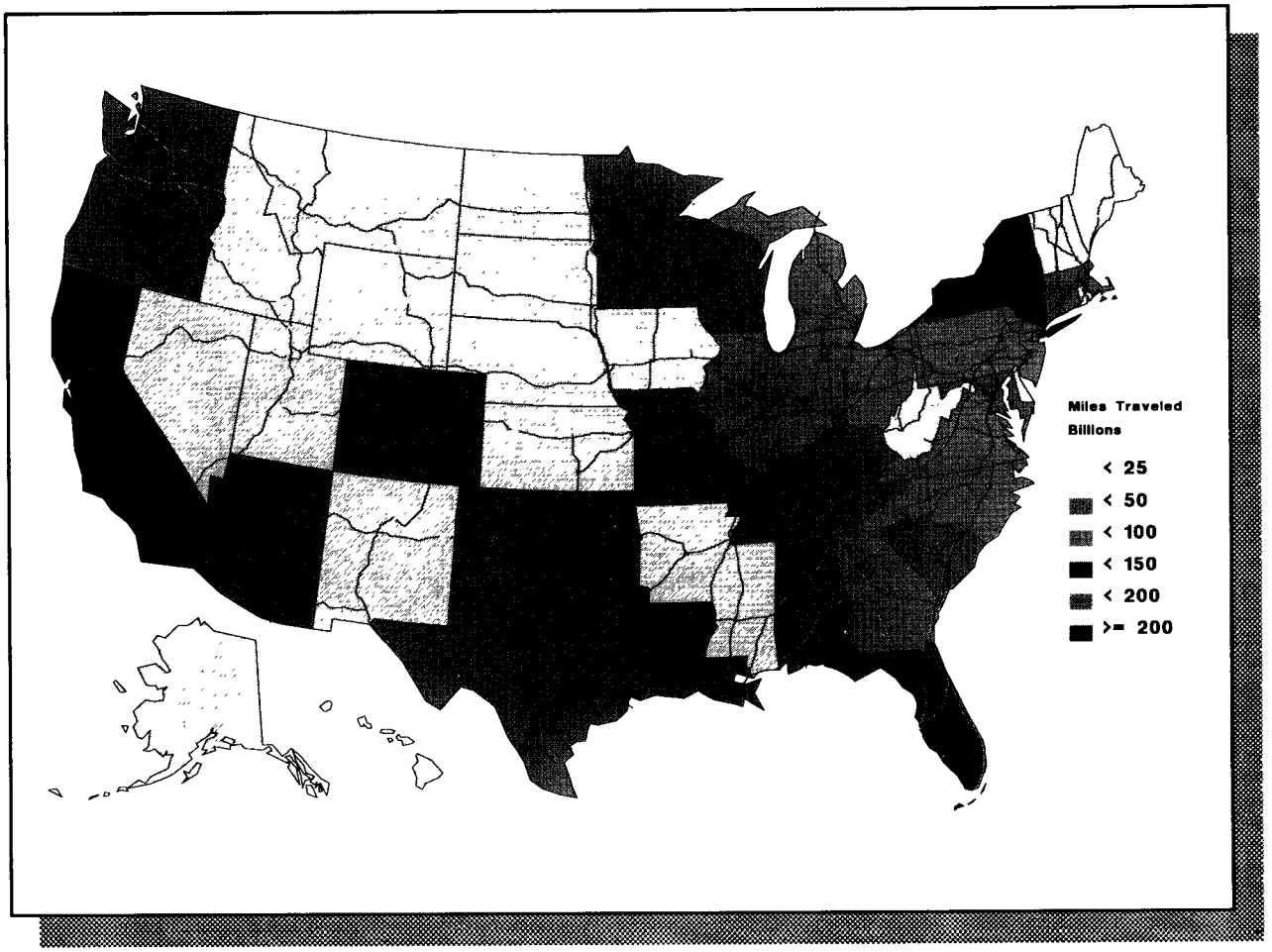
Example Monitoring Site



Population

This map shows the U.S. population in 1990, by county. Emissions reductions were achieved even though U.S. population increased 23 percent during the last 20 years.

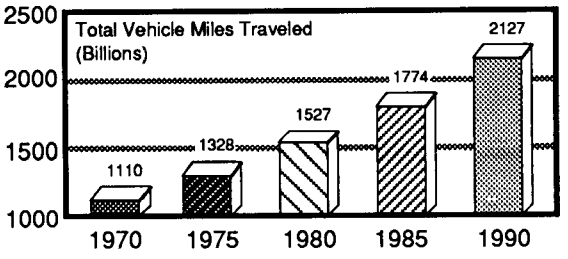


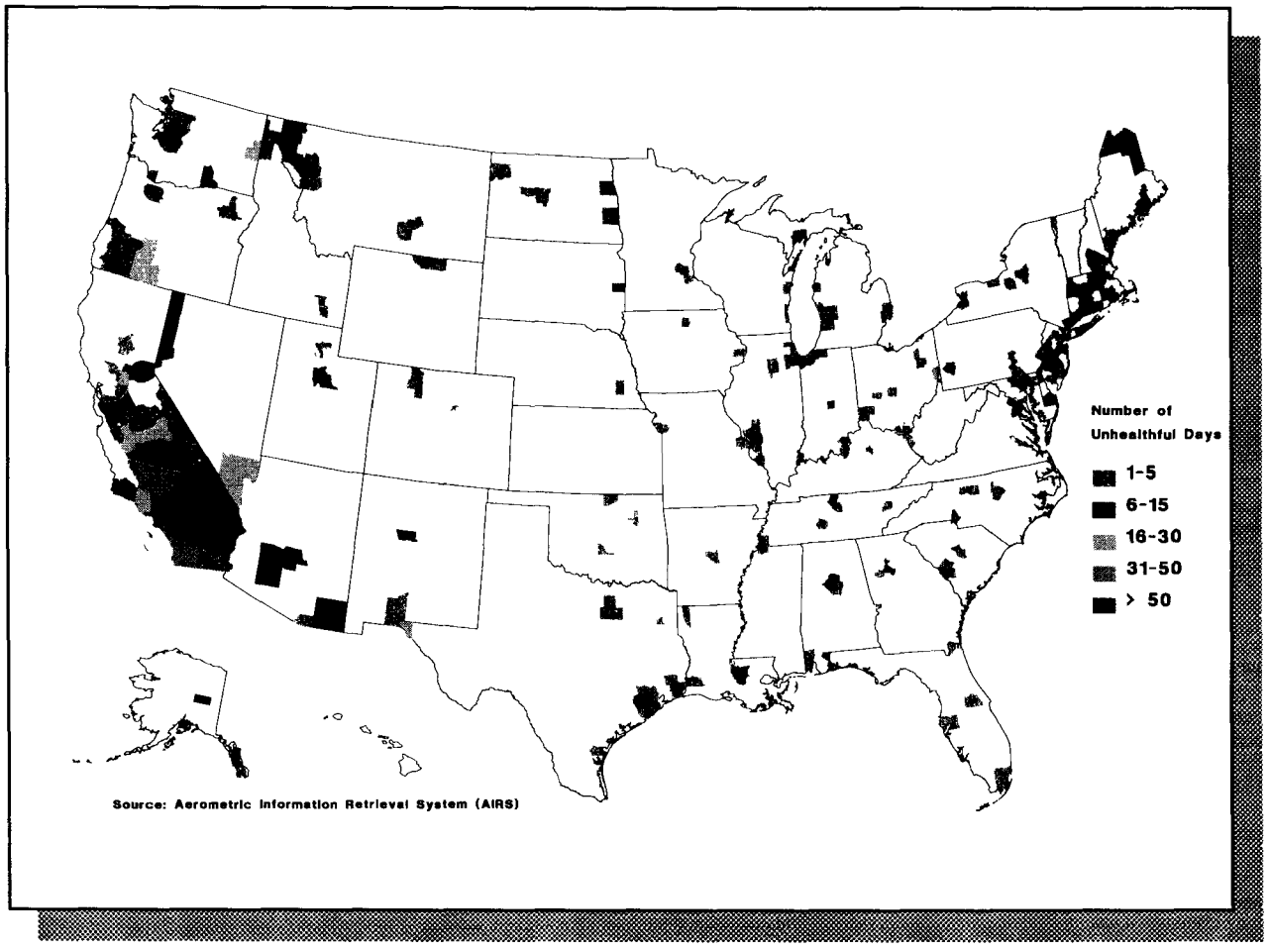


Highway Travel

The interstate highway system is shown superimposed on 1988 total vehicle miles traveled (VMT), by state. From 1970 to 1990, total VMT increased 92 percent.

U.S. VMT Growth

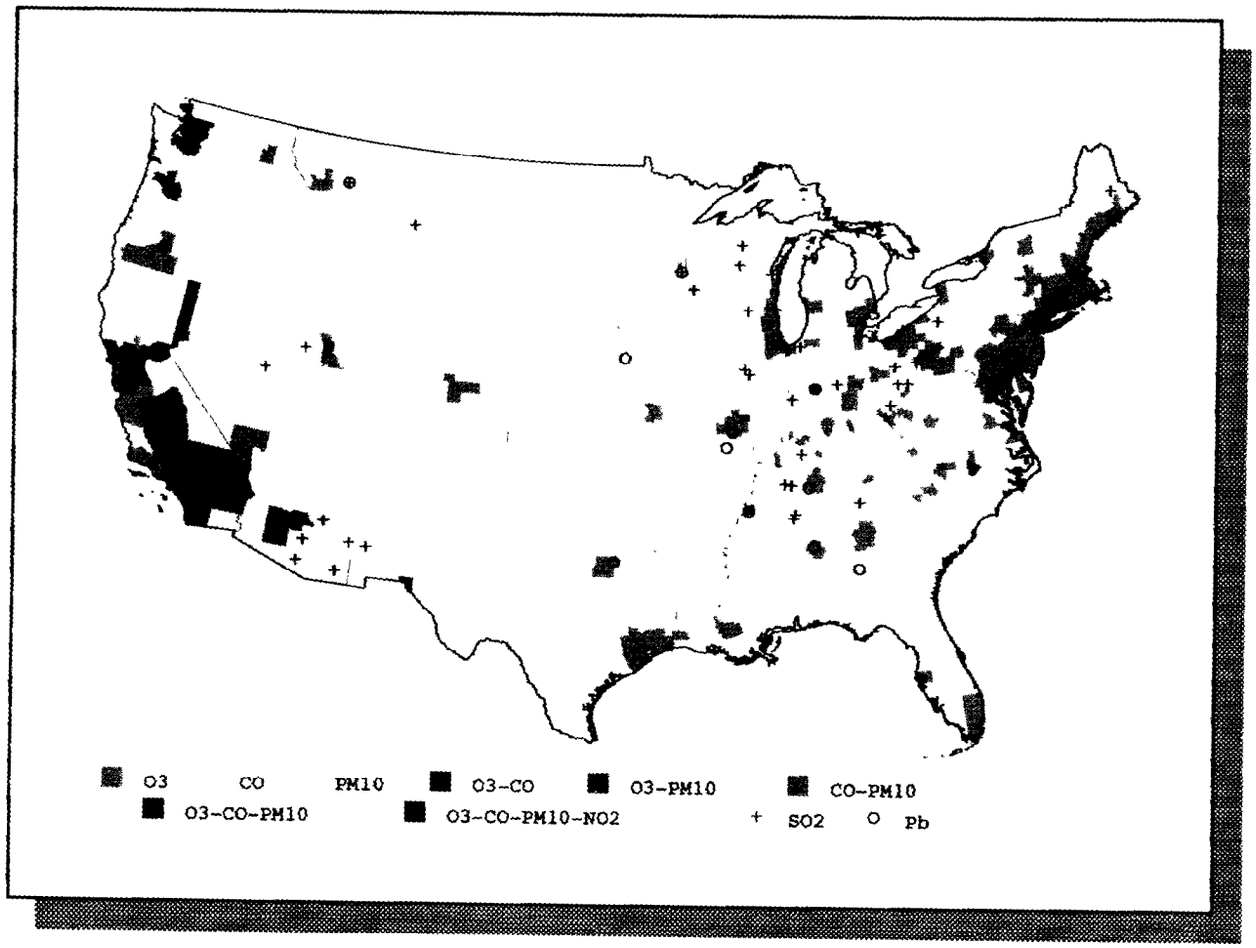




Pollutant Standards Index (PSI)

The PSI is a simple measure of air quality. This map shows the number of days with the PSI greater than 100 (unhealthful) for the NAAQS pollutants during 1990, by county.

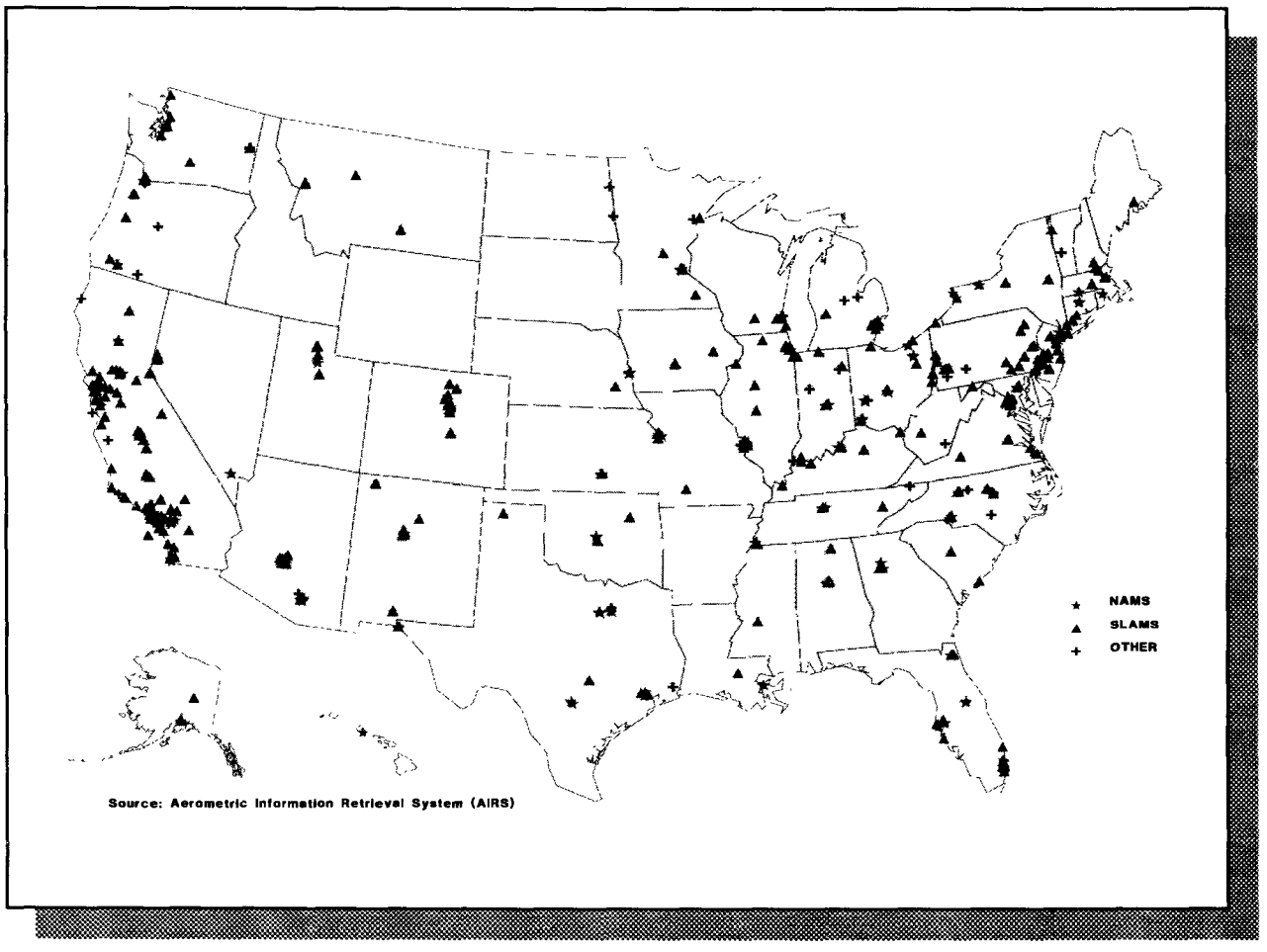
PSI	Descriptor
0 to 50	Good
51 to 100	Moderate
101 to 199	Unhealthful
200 to 299	Very Unhealthful
300 and above	Hazardous



Nonattainment Areas

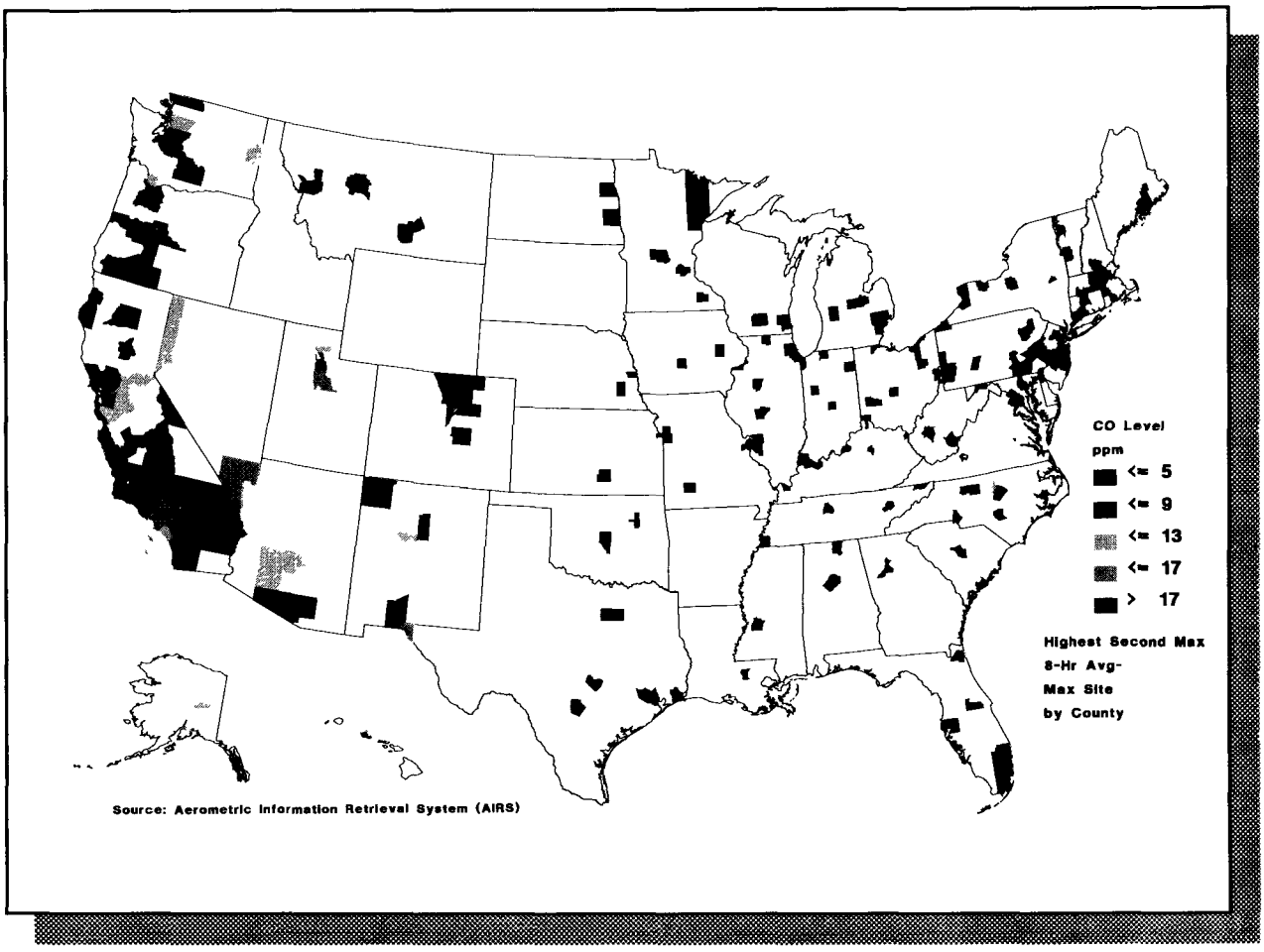
Areas not meeting air quality standards are called "nonattainment areas." This map shows counties that (as of October 1991) contain areas designated nonattainment under the Clean Air Act Amendments of 1990.

Pollutant	Number of Nonattainment Areas
Carbon Monoxide (CO)	42
Nitrogen Dioxide (NO_2)	1
Ozone (O_3)	98
Lead (Pb)	12
Particulates (PM-10)	70
Sulfur Dioxide (SO_2)	50



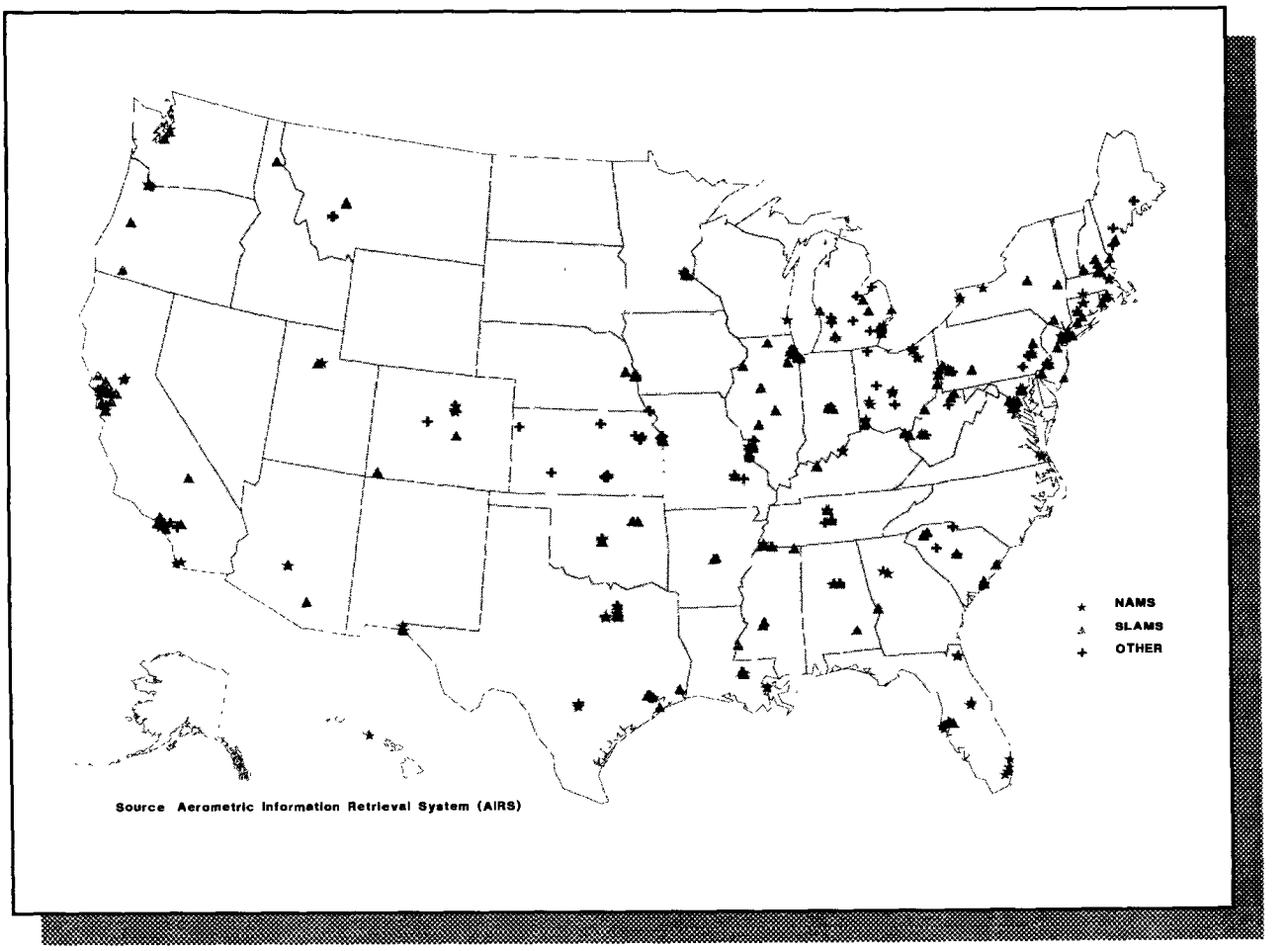
Carbon Monoxide Monitoring Network

This map displays the location and type of the 491 monitoring sites, in 236 counties, that reported carbon monoxide data for 1990. The main source of CO in cities is motor vehicle exhaust; other sources are wood-burning stoves, incinerators, and industrial processes.



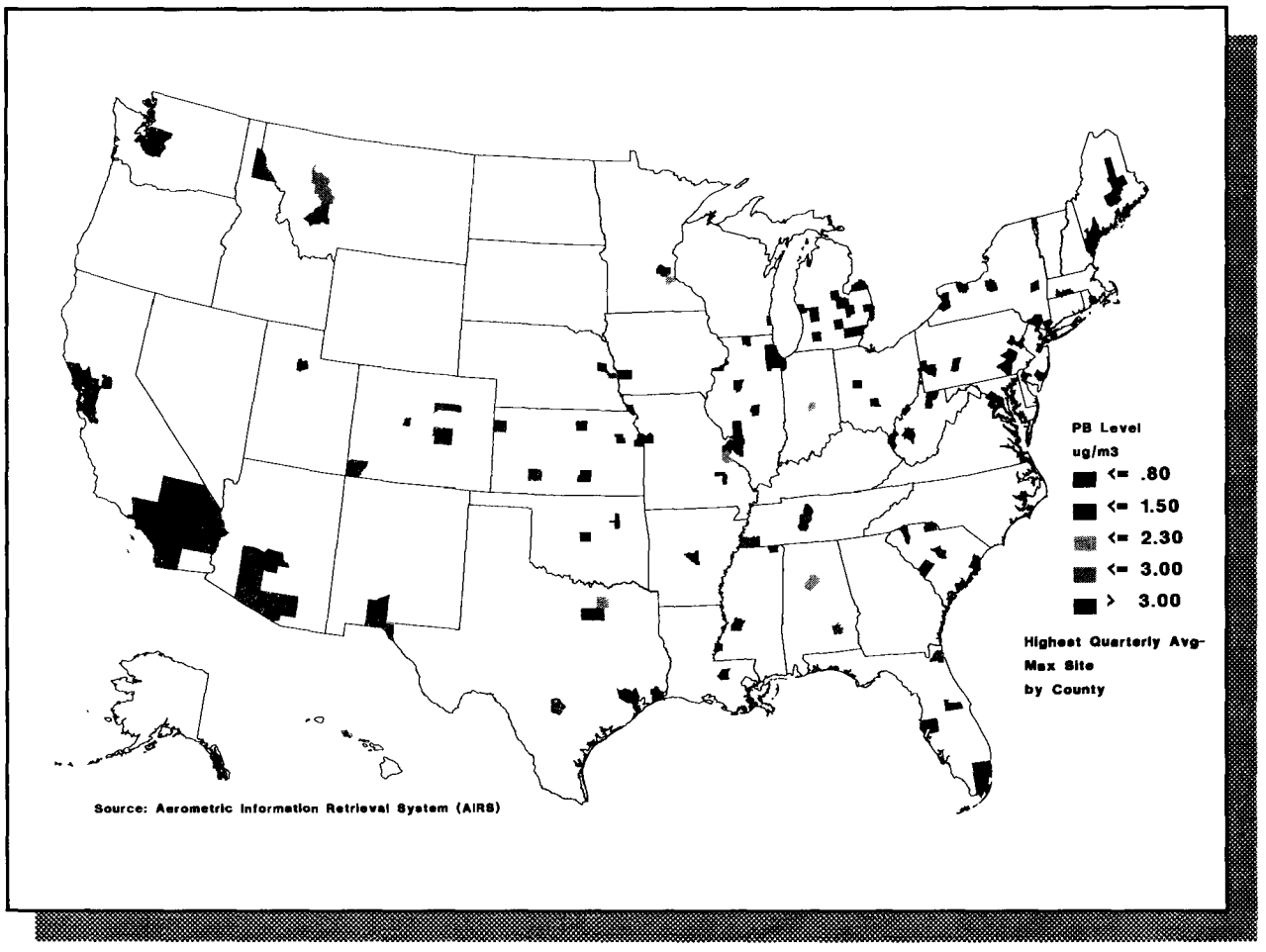
Carbon Monoxide Air Quality Concentrations, 1990

This map shows how carbon monoxide air quality concentrations varied by county in 1990. Counties in blue and green had 1990 air quality better than the level of the carbon monoxide 8-hour air quality standard. There were 23 counties (those in yellow, orange, and red) that had air quality worse than the CO standard. The air quality indicator shown is the second maximum nonoverlapping 8-hour average concentration at the peak site in each county.



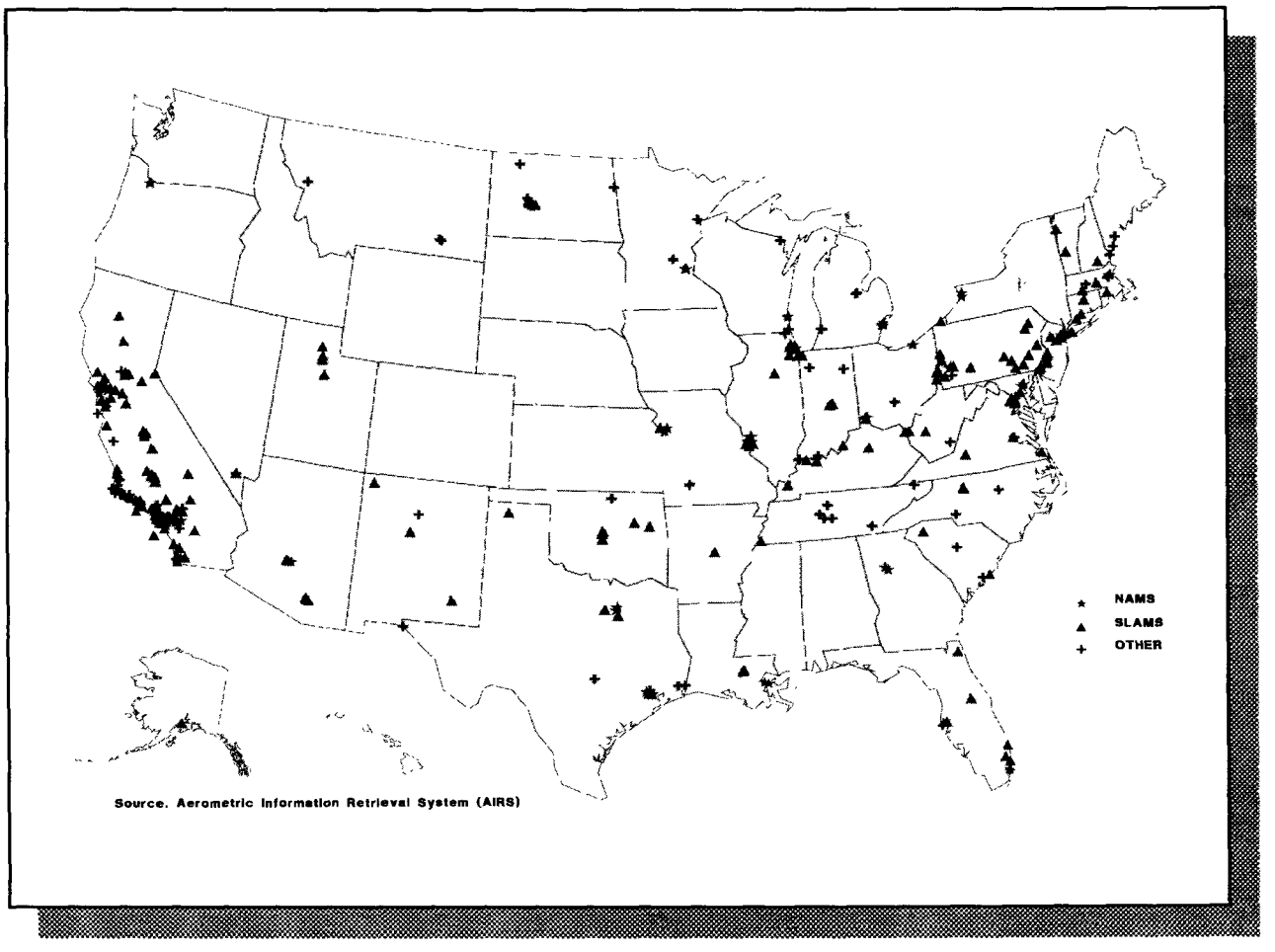
Lead Monitoring Network

This map displays the location and type of the 406 monitoring sites, in 184 counties, that reported lead data for 1990. Non-ferrous smelters, battery plants, and lead additives in gasoline are the major sources of lead emissions to the air. The use of unleaded gasoline and the phase-out of leaded gasoline have substantially reduced ambient lead levels in urban areas.



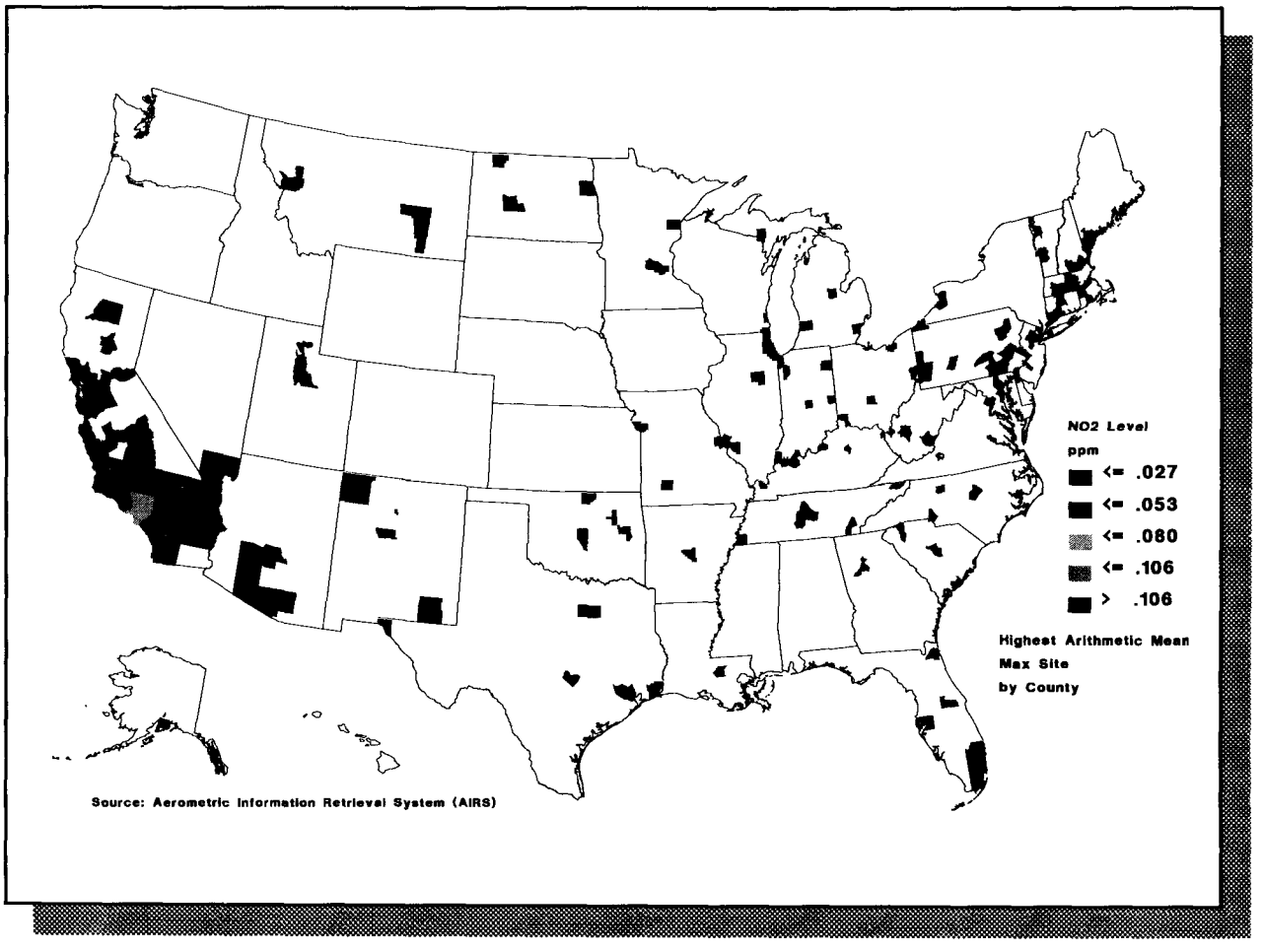
Lead Air Quality Concentrations, 1990

This map shows how lead air quality concentrations varied by county in 1990. Counties in blue and green had 1990 air quality better than the level of the lead air quality standard. The twelve counties (those in yellow, orange, and red) that had air quality worse than the level of the lead standard reflect the impact of localized lead sources. The air quality indicator shown is the maximum quarterly arithmetic mean concentration at the peak site in each county.



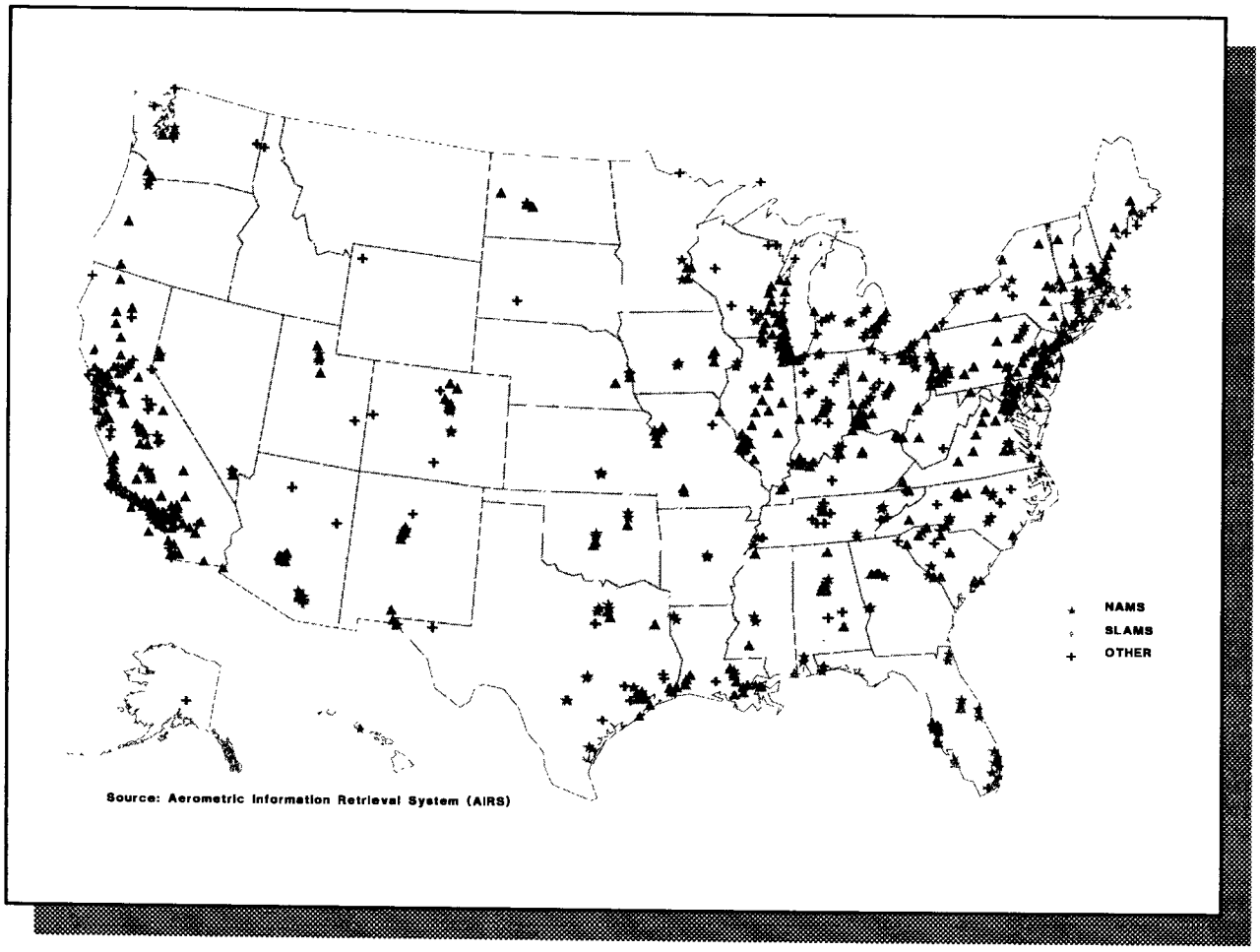
Nitrogen Dioxide Monitoring Network

This map displays the location and type of the 330 monitoring sites, in 163 counties, that reported nitrogen dioxide data for 1990. Most of these sites are in major urban areas. Nitrogen oxides are an important precursor to ozone and to acidic precipitation. The two major sources of nitrogen oxides are fuel combustion and highway vehicles.



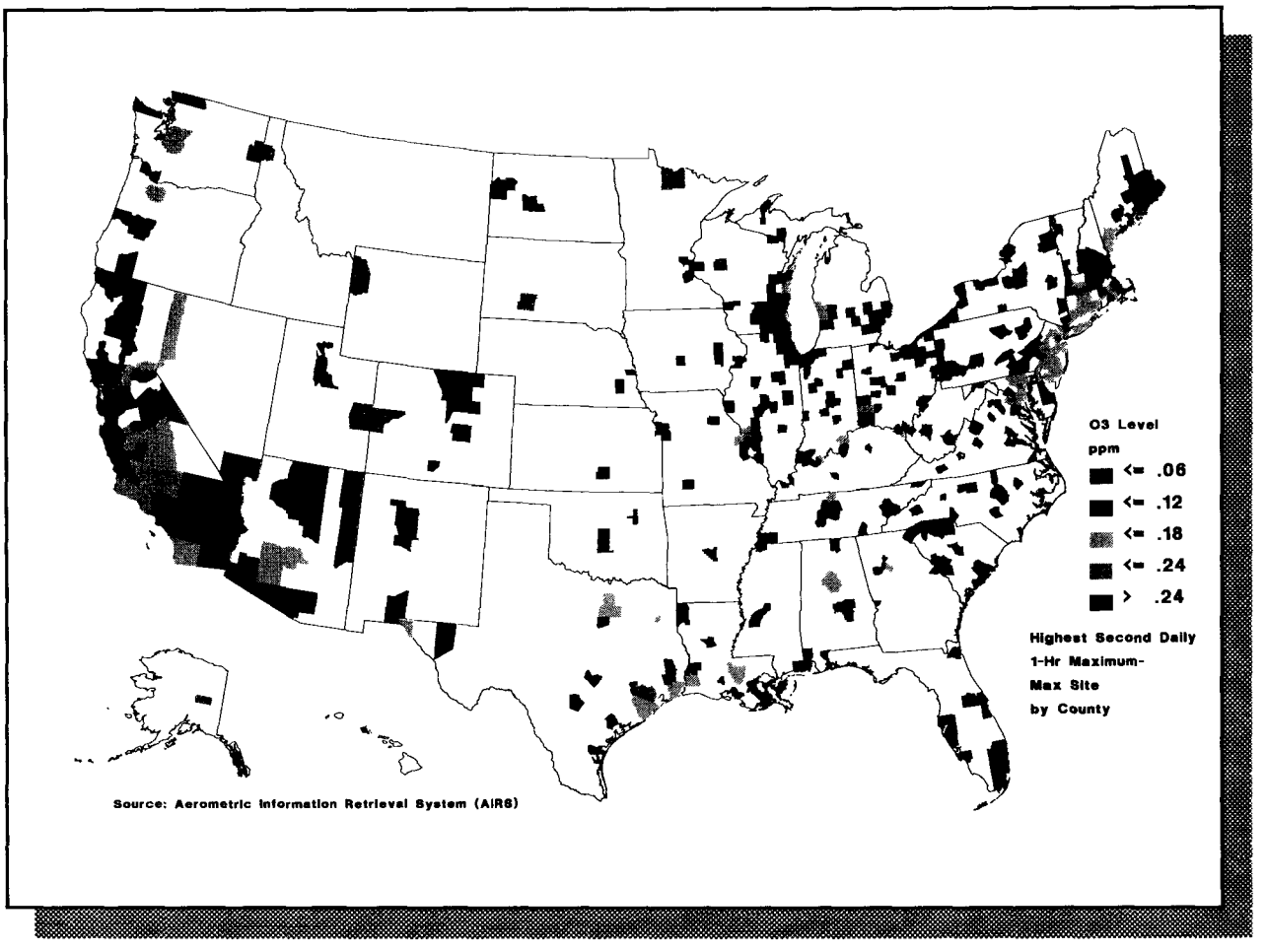
Nitrogen Dioxide Air Quality Concentrations, 1990

This map shows how nitrogen dioxide air quality concentrations varied by county in 1990. Los Angeles County (shown in yellow) is the only county in the United States that did not meet the NO_2 air quality standard in 1990. The air quality indicator shown is the annual arithmetic mean nitrogen dioxide concentration at the peak site in each county.



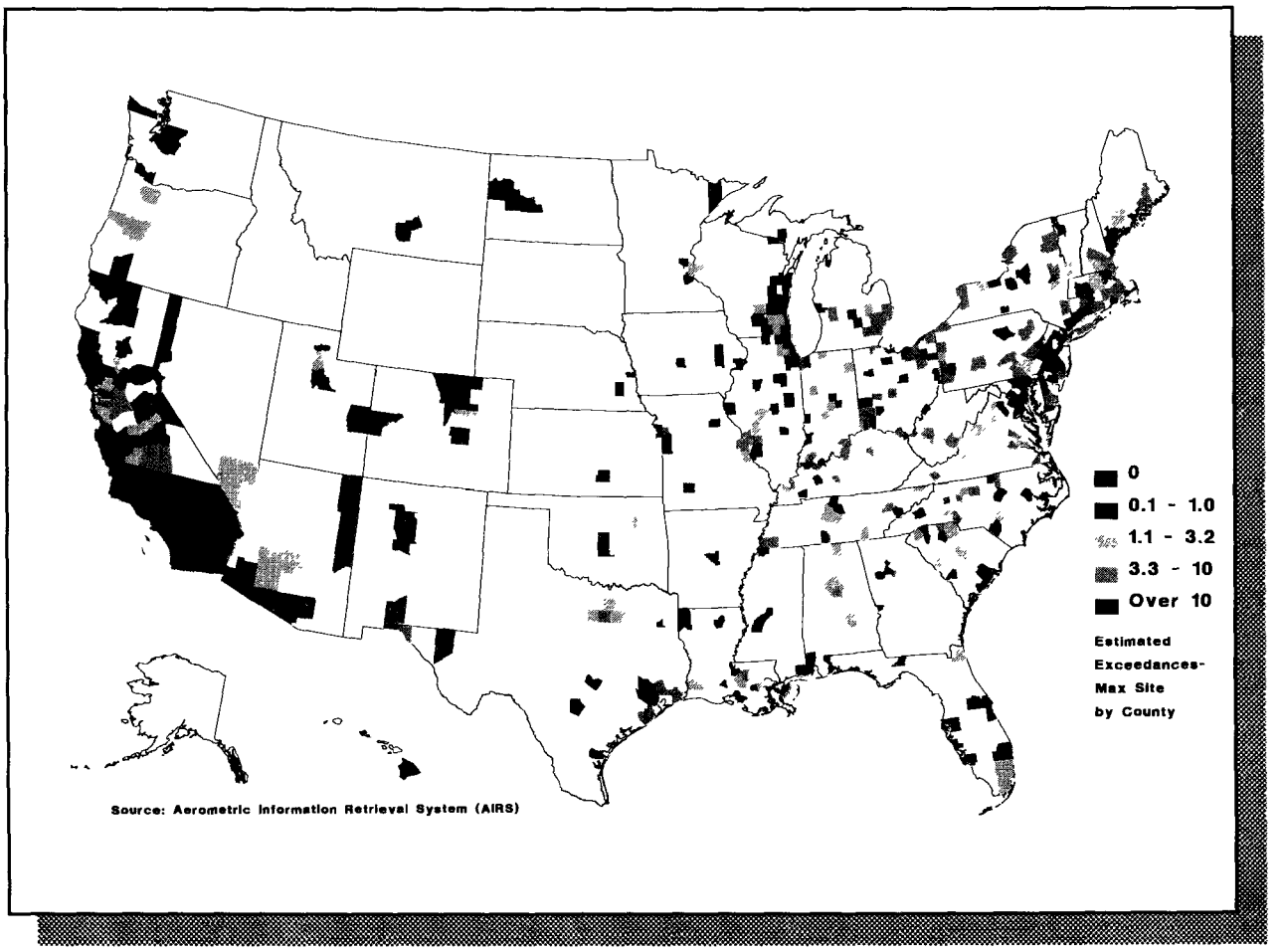
Ozone Monitoring Network

This map displays the location and type of the 812 ozone monitoring sites, in 467 counties, that reported air quality data for 1990. Ozone is not emitted directly into the air, but is created by sunlight acting on the precursor pollutants nitrogen oxides and volatile organic compounds. The sources of these precursors are diverse; examples include vehicle exhaust, gasoline vapors, chemical solvents, fuel combustion products, and even consumer products.



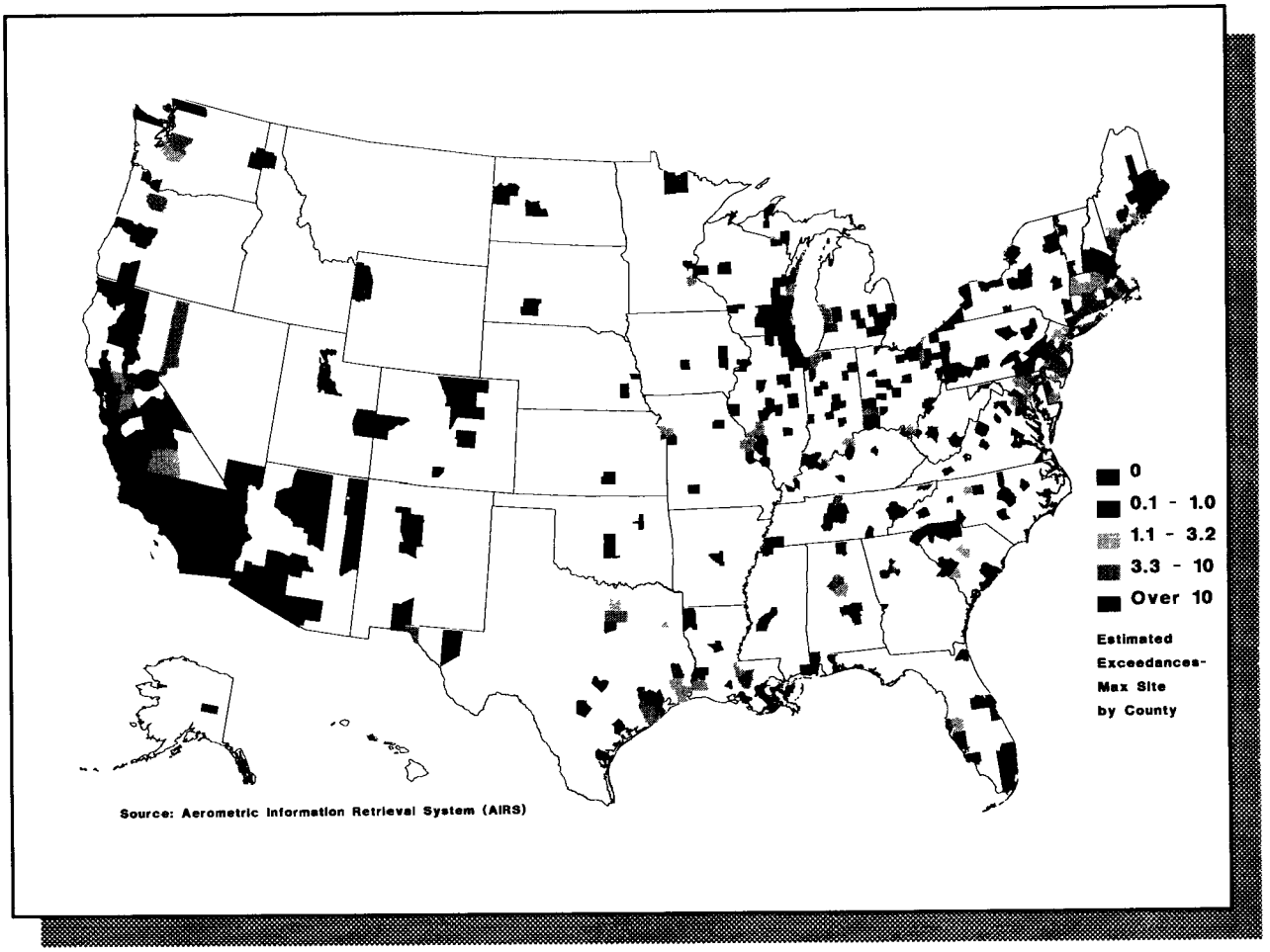
Ozone Air Quality Concentrations, 1990

This map shows how ozone air quality concentrations varied by county in 1990. Counties in blue and green had 1990 air quality better than the level of the ozone air quality standard. There were 89 counties (in yellow, orange, and red) that had air quality worse than the level of the ozone standard. The air quality indicator shown is the second daily maximum 1-hour average ozone concentration at the peak site in each county.



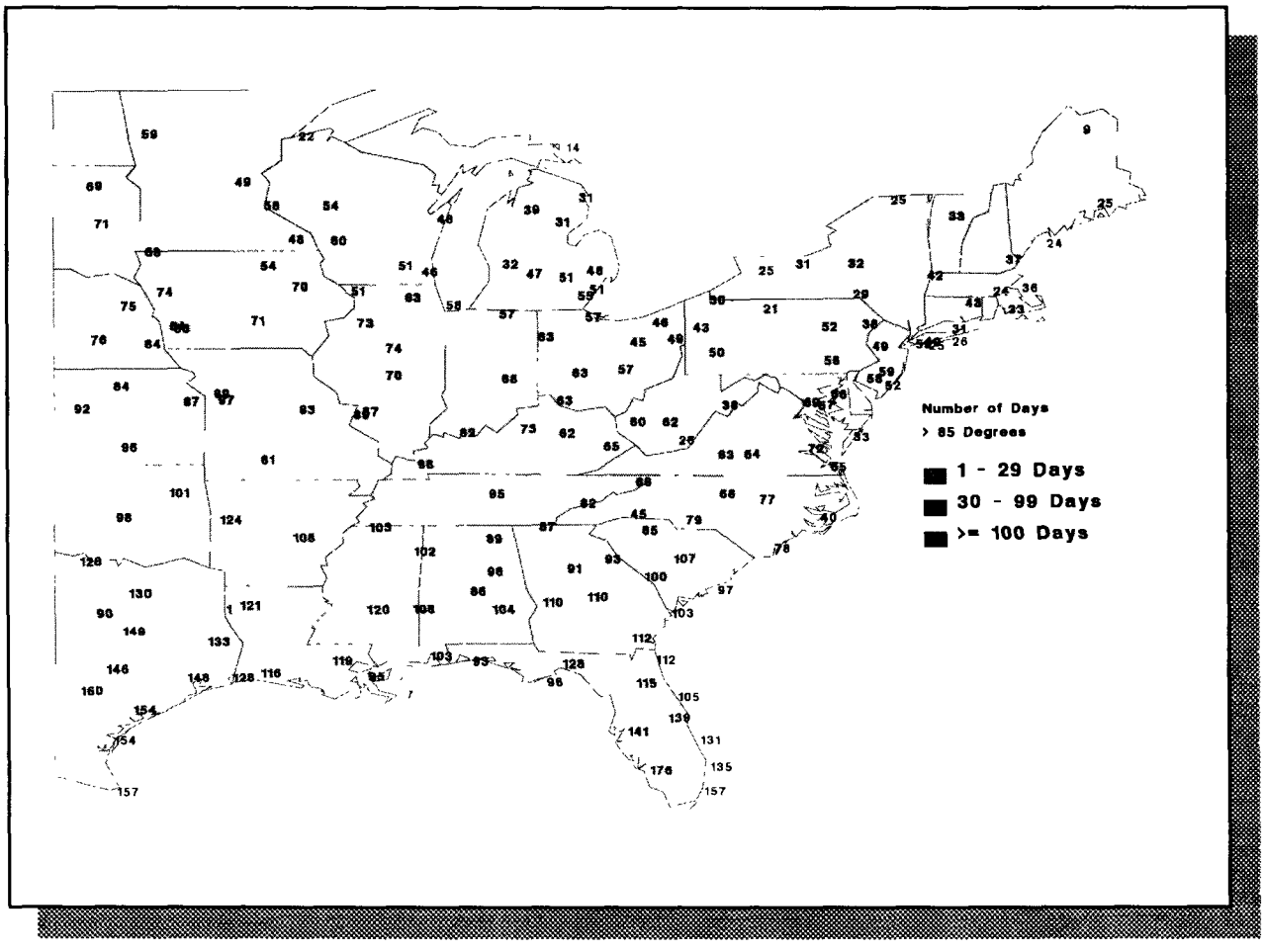
Exceedances of the Ozone Air Quality Standard, 1988

This map displays ozone exceedances in 1988 at the peak site in each county, estimated as required by the ozone standard. A total of 258 counties contained ozone monitoring sites that did not meet the ozone air quality standard (i.e., estimated exceedances of 1.1 or greater). Meteorological conditions during the hot, dry summer of 1988 were conducive to ozone formation.



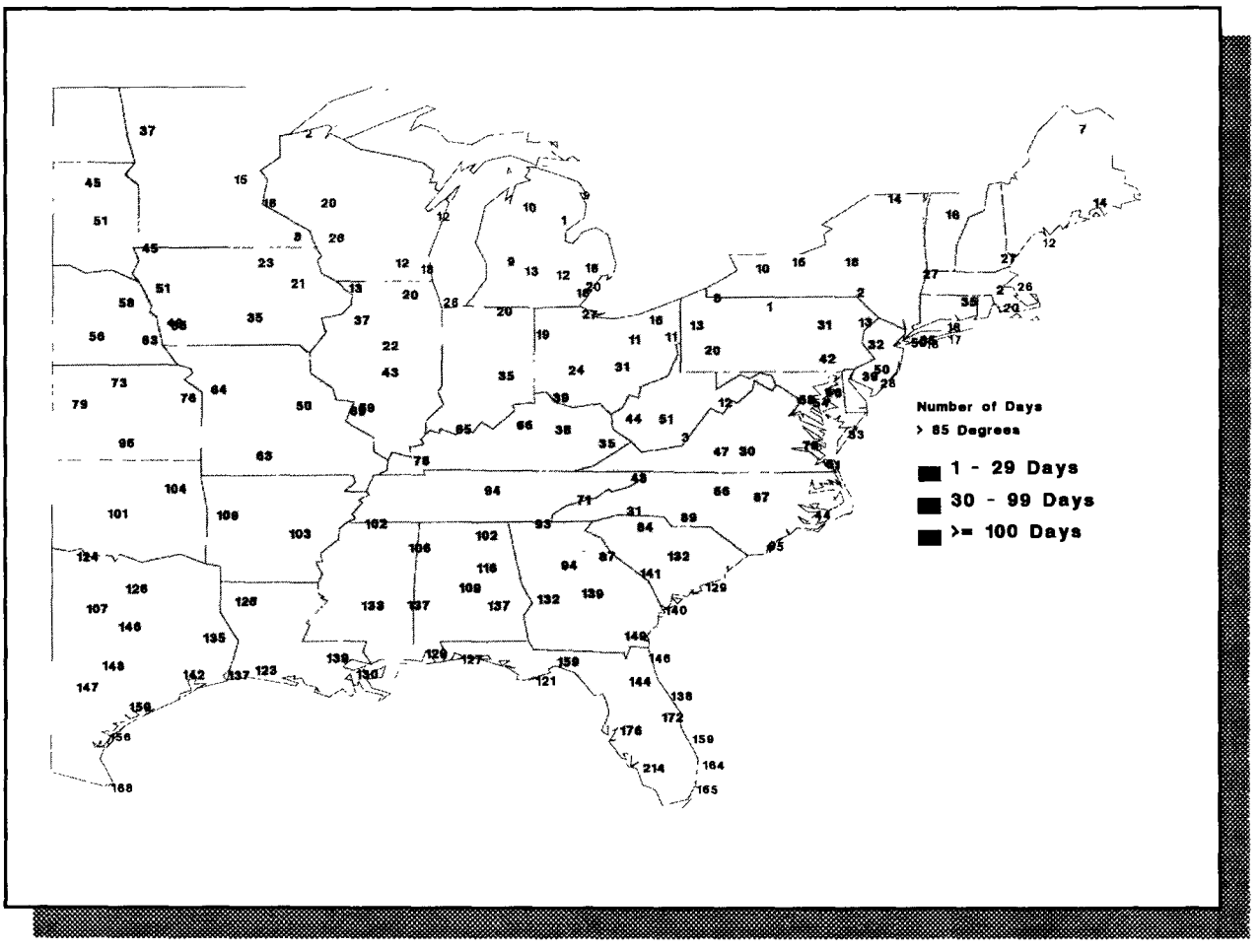
Exceedances of the Ozone Air Quality Standard, 1990

This map displays the exceedances of the ozone air quality standard in 1990 at the peak site in each county. A total of 115 counties contained ozone monitoring sites that did not meet the ozone air quality standard. Meteorological conditions in 1990 were not as conducive to ozone formation as conditions in 1988.



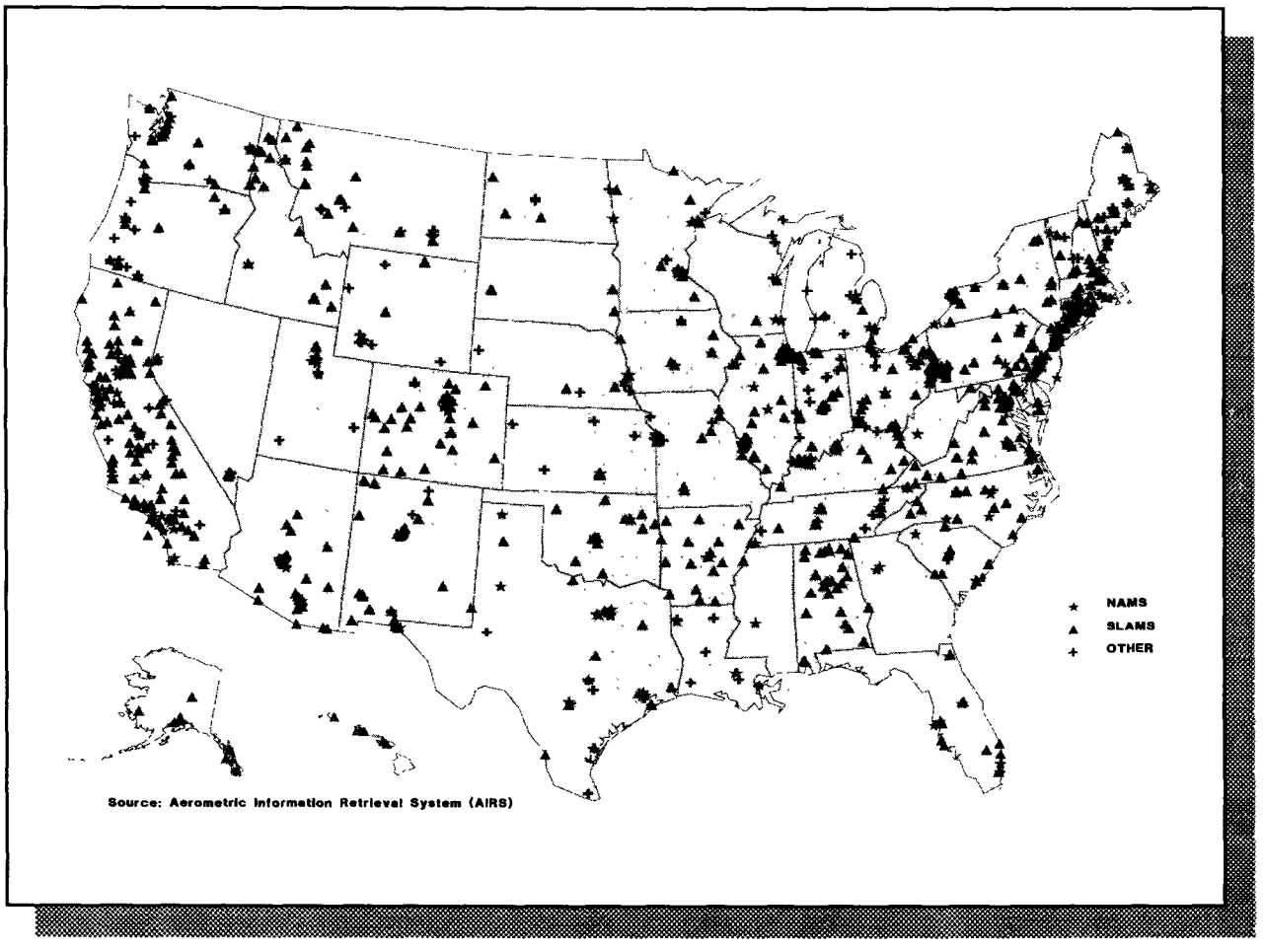
Number of Days with Maximum Daily Temperature Greater Than 85 Degrees Fahrenheit in the Eastern United States, 1988

This map shows the number of days that the maximum daily temperature exceeded 85°F as measured at National Weather Service WBAN stations. Hot, dry, stagnant meteorological conditions are conducive to the formation of ground-level ozone. Nationally, the summer of 1988 was the third hottest summer on record since 1895.



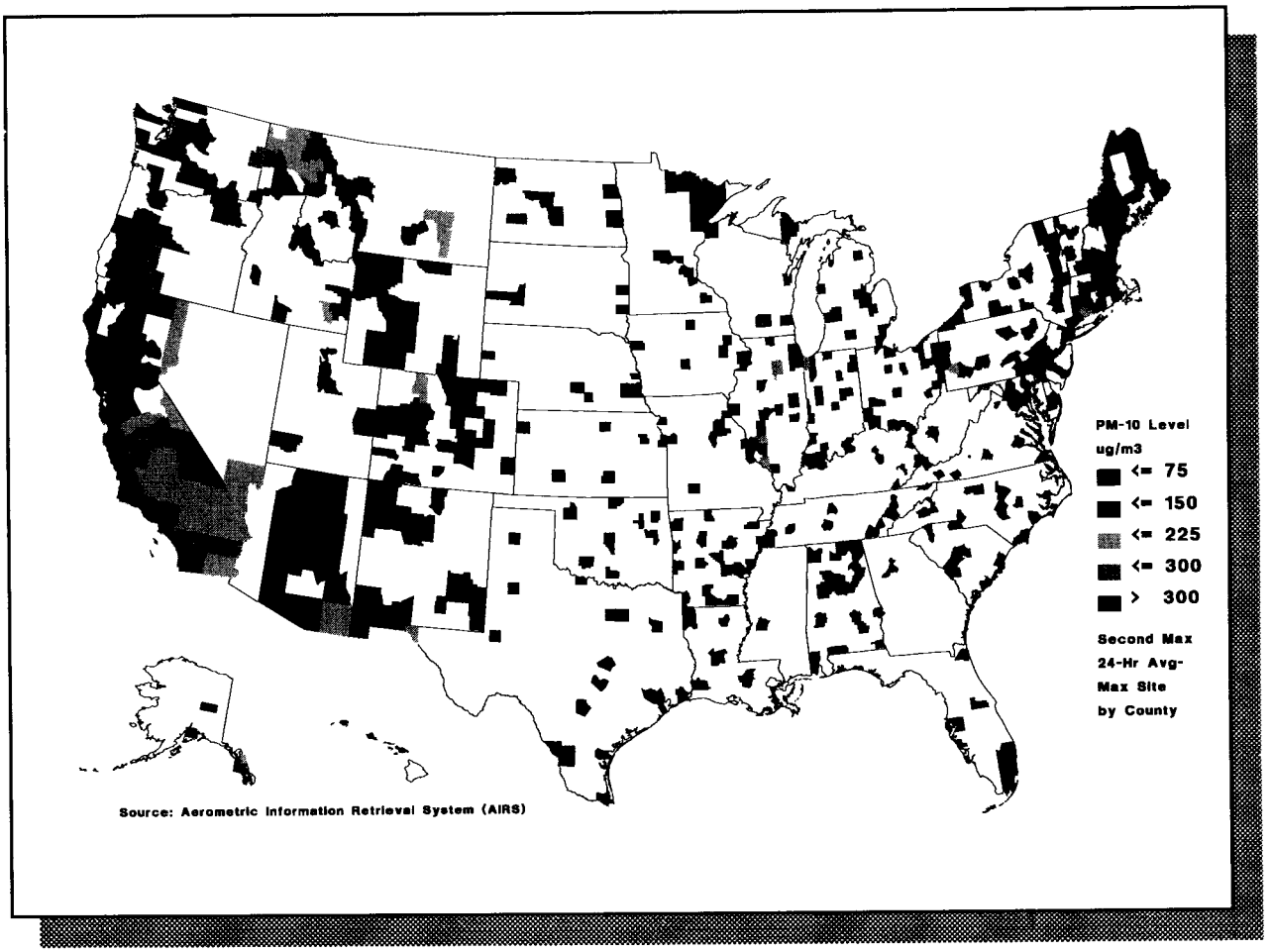
Number of Days with Maximum Daily Temperature Greater Than 85 Degrees Fahrenheit in the Eastern United States, 1990

This map shows the number of days that the maximum daily temperature exceeded 85°F as measured at National Weather Service WBAN stations. Nationally, the summer of 1990 was the fifteenth warmest summer since 1895. In contrast with 1988, the frequency of days with temperatures greater than 85°F is much lower in the northeastern and north central states.



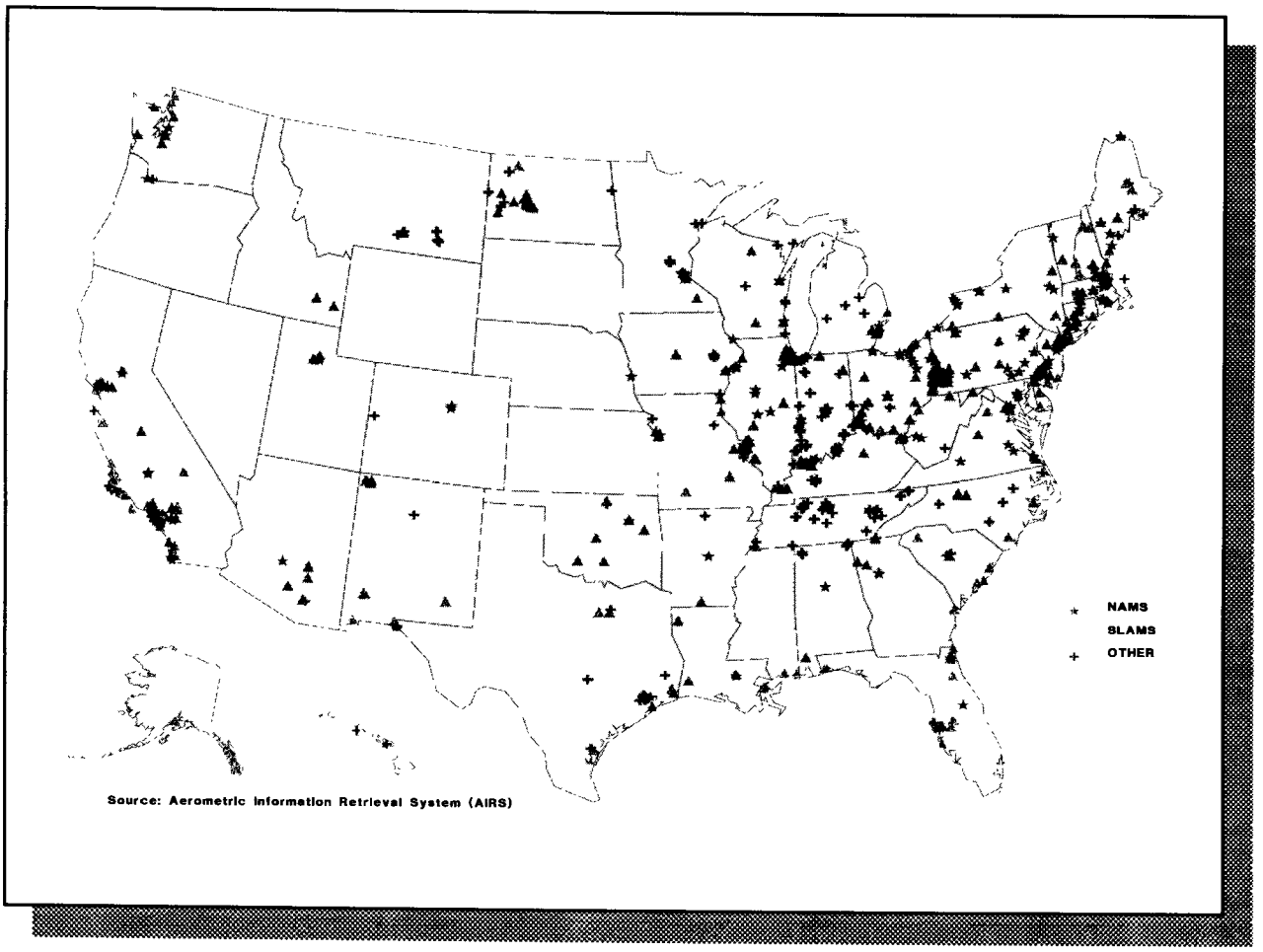
PM-10 Monitoring Network

This map displays the location and type of the 1,279 monitoring sites, in 572 counties, that reported PM-10 data for 1990. The PM-10 network has replaced the earlier network that measured total suspended particulate (TSP). Major PM-10 sources include industrial emissions, wood-burning stoves, open burning for forest management and agricultural purposes, and urban dust.



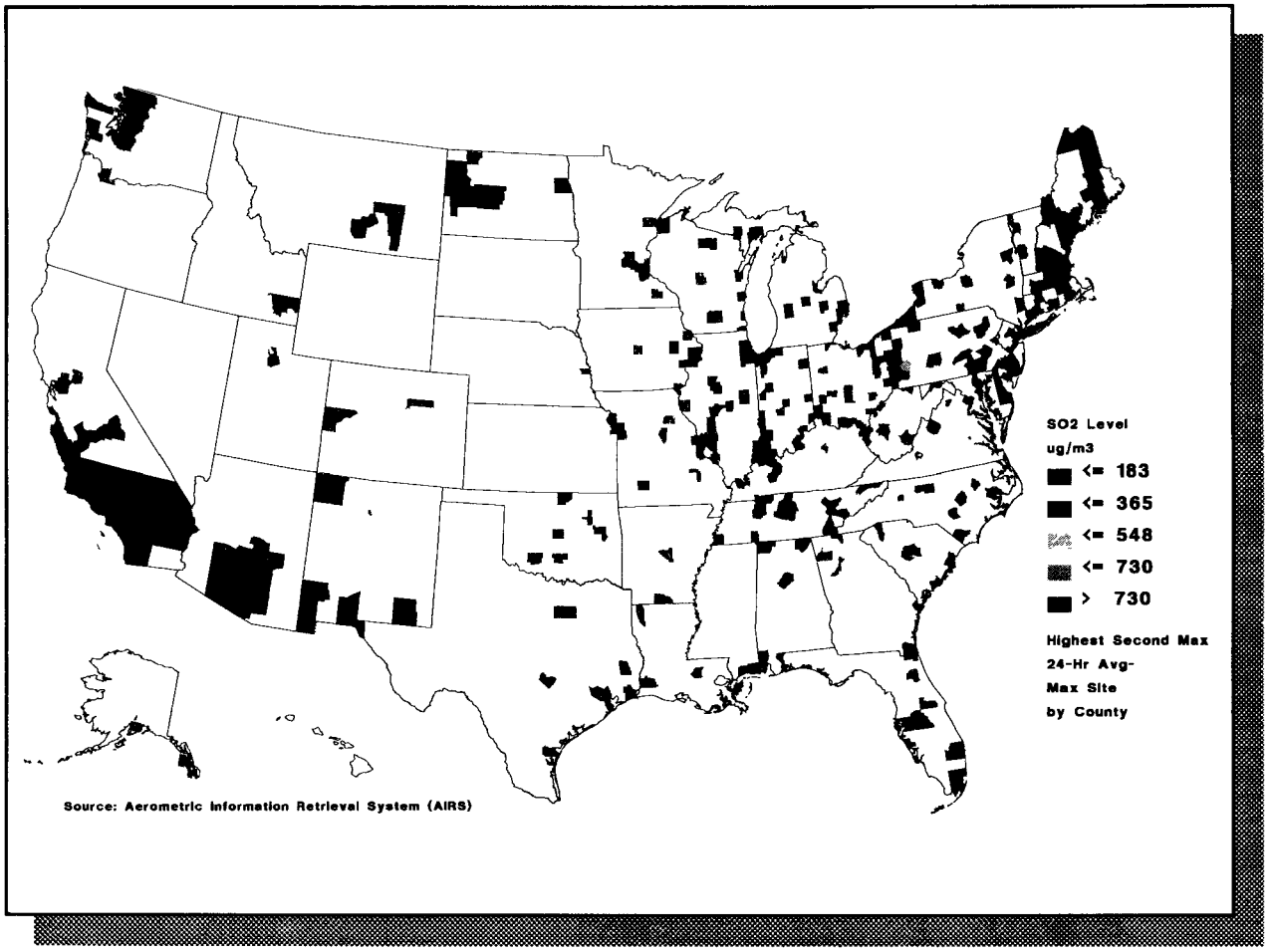
PM-10 Air Quality Concentrations, 1990

This map shows how PM-10 air quality varied by county in 1990. Counties in blue and green had 1990 air quality better than the level of the 24-hour PM-10 air quality standard. Thirty-three counties (in yellow, orange, and red) had air quality worse than the level of the PM-10 standard in 1990. The air quality indicator shown is the second maximum 24-hour average PM-10 concentration at the peak site in each county.



Sulfur Dioxide Monitoring Network

This map displays the location and type of the 741 monitoring sites, in 369 counties, that reported sulfur dioxide data for 1990. Most of these sites are population-oriented monitoring sites in urban areas, while the major sulfur oxides emissions sources (e.g., smelters and coal-fired power plants) tend to be in less populated areas.



Sulfur Dioxide Air Quality Concentrations, 1990

This map shows how sulfur dioxide air quality concentrations varied by county in 1990. Only one county (Allegheny County, PA) had air quality that did not meet the sulfur dioxide 24-hour air quality standard in 1990. The air quality indicator shown is the second maximum 24-hour average sulfur dioxide concentration at the peak site in each county.