2009

AMBIENT AIR MONITORING

IN MIAMI-DADE COUNTY

AMBIENT AIR

Air is a mixture of many different gases. The two major gases are oxygen and nitrogen. Together they comprise 99 percent of the dry mixture. Water vapor varies from 1-3 percent of the total mixture. The table below is percent by volume of dry air.

Name	% by Volume
Nitrogen	78.084
Oxygen	20.9476
Argon	0.934
Carbon Monoxide	0.0314
Neon	0.001818
Methane	0.0002
Helium	0.000524
Krypton	0.000114
Hydrogen	0.00005
Xenon	0.0000087

Table 1. Dry Air Composition

AIR POLLUTANTS AND STANDARDS

Air pollutants, emitted by pollution sources both inside and outside Miami-Dade County, can adversely affect Miami-Dade County's air quality. The County's air pollutants of concern are primarily Ozone (O_3) and Particulate Matter (PM10 and PM2.5). Ozone is the pollutant for which Miami-Dade County has been designated in the past as a non-attainment area.

The Clean Air Act of 1970 (http://www.epa.gov/air/caa/) defined six criteria pollutants and established ambient concentration limits to protect public health and welfare. EPA periodically has revised the original concentration limits and methods of measurement, most recently in 2008. The criteria pollutants are ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), particulates (PM10 [particulate matter with a diameter of 10 microns or less] and PM2.5 [particulate matter with a diameter of 2.5 microns or less, also called PM_{fine}]), sulfur dioxide (SO2) and lead (Pb). All of the criteria pollutants, with the exception of ozone, are emitted by mobile and stationary sources, including motor vehicles, industrial, agricultural and natural sources. You might expect that EPA would track emissions of the same pollutants. However, ozone, an area wide pollutant, is not emitted directly; it forms by chemical reactions of volatile organic compounds (VOC) with nitrogen oxides (NOx) in the air, mediated by sunlight. Therefore, EPA tracks emissions of ozone precursors (volatile organic compounds and nitrogen oxides) and three other criteria pollutants:

- Carbon monoxide (CO)
- Sulfur dioxide (SO2)

- Particulate matter (PM10 and PM2.5)

Two types of National Ambient Air Quality Standards (NAAQS) (http://www.epa.gov/ttn/naaqs/) were defined: primary and secondary. Primary standards were designed to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards were designed to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

On September 16, 1997, the old ozone standard (0.12 ppm 1-hour average) was replaced with a new standard (0.08 ppm) and a new PM2.5 standard (Annual Arithmetic Mean of 15 ug/m^3 and Maximum 24-hour Value of 65 ug/m^3) was added. To attain the new ozone standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm. The ozone standard was rendered unenforceable by a lawsuit in May 1998. On March 26, 2002 a federal appeals court upheld the new ozone standard. As of June 15, 2005, EPA revoked the 1-hour ozone standard (http://www.epa.gov/air/oaqps/greenbk/oindex.html) in all areas except the 8-hour ozone nonattainment Early Action Compact (EAC) Areas, which do not include Miami-Dade County (http://www.epa.gov/air/eac). Effective May 27, 2008, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentration was changed from 0.080 ppm to 0.075 ppm. Effective December 17, 2006, the 24-hour PM2.5 standard was changed from 65 ug/m^3 to 35 ug/m^3. To meet this standard the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$. The lead standard was changed to 0.15 ug/m^3 rolling 3-month average on October 15, 2008.

The six criteria pollutants and their respective standards are listed in Table 2. The spatial distribution of pollutant monitors throughout Miami-Dade County is shown in Figure 1.

As part of the Federal Clean Air Act Amendments (CAAA) of 1977, states and local governments were required to develop State Implementation Plan (SIP) revisions for all areas that were not attaining the NAAQS. Subsequent to these amendments, the EPA developed a list of "non-attainment" areas on a pollutant-by-pollutant basis. The list, which constituted formal notification, was published in the September 12, 1978, Federal Register. The counties of Broward, Miami-Dade and Palm Beach were among those listed as being non-attainment for photochemical oxidants; i.e., ozone. The 1-hour ozone NAAQS was 0.12 ppm averaged over one hour. More than three exceedances at a specific site over a consecutive three-year period could result in a non-attainment designation for ozone. A NAAQS violation exists once the fourth consecutive exceedance occurs at that specific site. The exceedances are tracked on a consecutive three-year basis. They were attainment for the other pollutants. The CAAA of 1977 also set specific steps for attainment and deadline dates that had to be met by the designated areas.

Although designated areas across the country attempted to meet the NAAQS by their respective deadlines, the realization surfaced that the target deadlines specified were unattainable as originally envisioned. In addition, it appeared that the CAAA of 1977 did not provide the most effective means to handle the problems associated with ozone non-attainment areas. The Clean Air Act Amendments required modification to facilitate reaching the goals in a more expeditious manner.

In November 1990, new Clean Air Act Amendments were passed. With these amendments, the U.S. Congress revised the mechanism used to meet attainment deadlines. The previously defined non-attainment areas were further subcategorized based upon severity of pollution, deadlines were revised and sanctions, originally reserved for non-attainment, were utilized as a means of ensuring compliance with the 1990 CAAA. Additionally, the CAAA also provided a mechanism for non-attainment areas to obtain redesignation once the area had achieved and maintained the NAAQS.

The tri-county area comprised of Broward, Dade and Palm Beach counties, was designated a moderate non-attainment area for ozone, so the EPA assigned an attainment deadline of 1996 for the area, commonly referred to as the Southeast Florida Airshed.

In response to the need to ensure compliance with the 1990 CAAA, state and local agencies in the Southeast Florida Airshed initiated several new pollution control programs. As soon as validated air monitoring data was available for the airshed to demonstrate conformance with the NAAQS, tri-county agencies were in a position to qualify and apply for redesignation to ozone attainment / maintenance status.

The tri-county area redesignation request and accompanying SIP revision was submitted to the EPA through the FDEP during November 1993. The EPA subsequently approved the SIP revision and redesignation request on April 27, 1995. The tri-county area became an ozone attainment area.

Table 2. EPA's Six Criteria Pollutants and their Corresponding Standards

Ambient Air Quality Standards

	Primary Standards		Secondary Standards		State of Florida	Miami-Dade County
Pollutant	**Level**	**Averaging Time**	**Level**	**Averaging Time**	**Level**	**Averaging Time**
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour[1]	None		Same as Primary	Same as Primary
	35 ppm (40 mg/m^3)	1-hour[1]			Same as Primary	Same as Primary
Lead	0.15 $\mu g/m^3$ [2]	Rolling 3-Month Average	Same as Primary		Same as Primary	Same as Primary
	1.5 $\mu g/m^3$	Quarterly Average	Same as Primary		Same as Primary	Same as Primary
Nitrogen Dioxide	0.053 ppm (100 $\mu g/m^3$)	Annual (Arithmetic Mean)	Same as Primary		Same as Primary	Same as Primary
Particulate Matter (PM_{10})	150 $\mu g/m^3$	24-hour[3]	Same as Primary		Same as Primary	Same as Primary
Particulate Matter ($PM_{2.5}$)	15.0 $\mu g/m^3$	Annual[4] (Arithmetic Mean)	Same as Primary		Same as Primary	Same as Primary
	35 $\mu g/m^3$	24-hour[5]	Same as Primary		Same as Primary	Same as Primary
Ozone	0.075 ppm (2008 std)	8-hour [6]	0.075 ppm (2008 std)		Same as Primary	Same as Primary
	0.08 ppm (1997 std)	8-hour [7]	0.08 ppm (1997 std)		Same as Primary	Same as Primary
	0.12 ppm	1-hour [8] (Applies only in limited areas)	0.12 ppm		Same as Primary	Same as Primary
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Mean)			0.02	0.007
	0.14 ppm	24-hour[1]			0.10	0.040
			0.5 ppm (1300 $\mu g/m^3$)	3-hour[1]	0.50	0.13

Units of measure for the standards are parts per million (ppm) by volume, milligrams per cubic meter of air (mg/m^3), and micrograms per cubic meter of air ($\mu g/m^3$).

[1] Not to be exceeded more than once per year.

[2] Final rule signed October 15, 2008.

[3] Not to be exceeded more than once per year on average over 3 years.

[4] To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 15.0 $\mu g/m^3$.

[5] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 μg/m^3 (effective December 17, 2006).

[6] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).

[7] (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.

[8] (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.

(b) As of June 15, 2005 EPA revoked the 1-hour ozone standard in all areas except the 8-hour ozone nonattainment Early Action Compact (EAC) Areas.

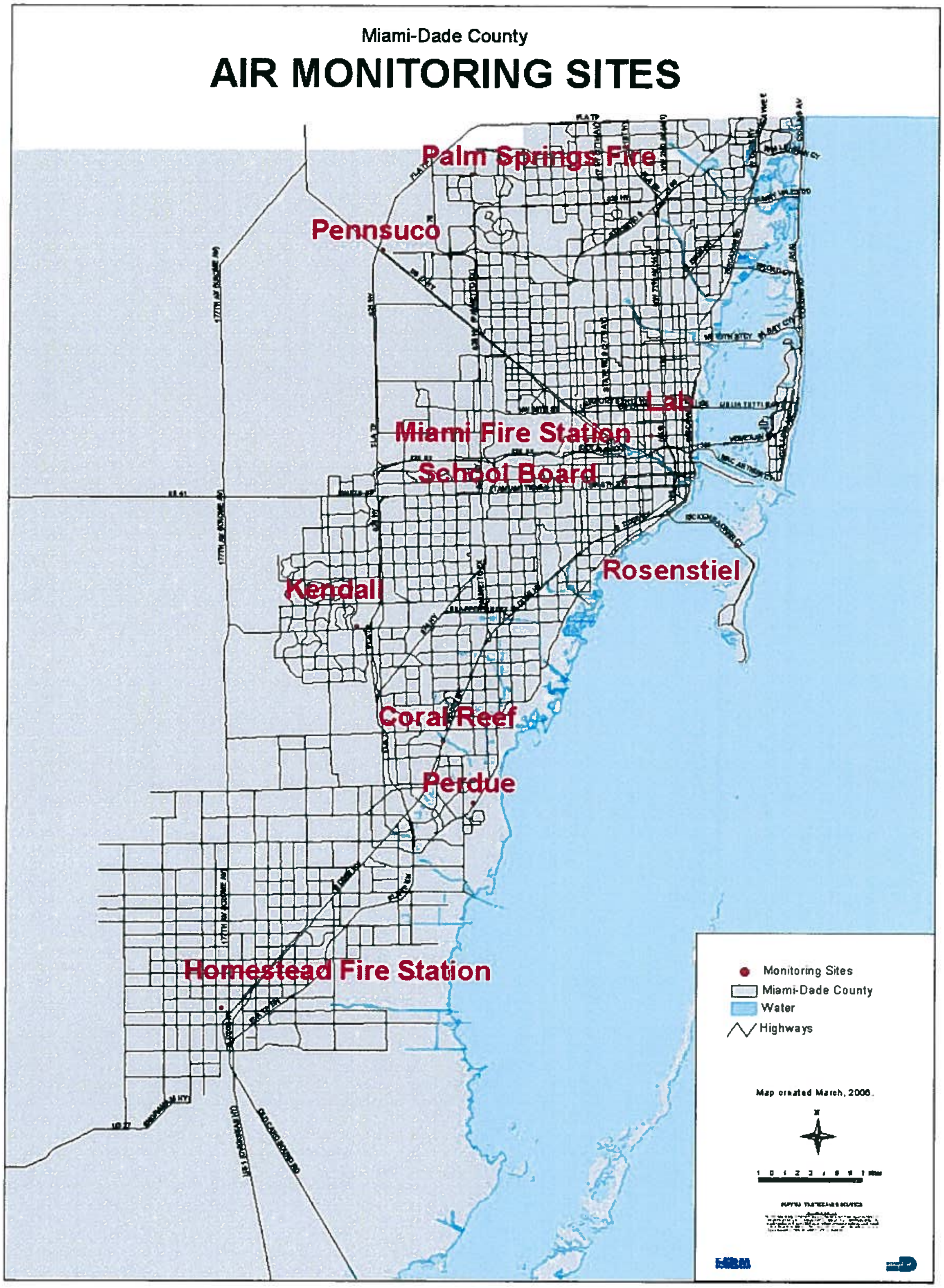


Figure 1. Miami-Dade County Air Monitoring Sites – 2009

OZONE (O_3)

Ozone is an odorless, colorless gas composed of three atoms of oxygen. Ozone occurs both in the Earth's upper atmosphere and at ground level and is considered good or bad, depending on where it is found:

> Good ozone is when ozone occurs naturally in the Earth's upper atmosphere—10 to 30 miles above the Earth's surface—where it forms a protective layer that shields us from the sun's harmful ultraviolet rays. Manmade chemicals are gradually destroying this beneficial ozone. An area where ozone has been significantly depleted—for example, over the North or South Pole—is sometimes called a "hole in the ozone layer."
>
> Bad Ozone is formed in the Earth's lower atmosphere, near ground level. It is formed by a chemical reaction between oxygen (O_2), nitrogen dioxide (NO_2) and reactive volatile organic compounds (VOCs) in the presence of sunlight. Some VOC sources include hydrocarbons in automobile exhaust and vapors from cleaning solvents or gasoline fueling stations. Other sources of these pollutants are power plants, industrial boilers, refineries and chemical plants. Ozone at ground level is a harmful pollutant. Ozone pollution is a concern during the summer months, when the weather conditions needed to form it—lots of sun, hot temperatures— normally occur.

Ozone is an irritant of the mucous membranes of the nose, throat and airways. Symptoms associated with ozone exposure include coughing, chest pain and throat irritation. Ozone can also increase susceptibility to respiratory infection, impair normal functioning of the lungs and reduce one's ability to perform physical exercise. All of these effects are exacerbated in individuals having a sensitive respiratory system. Studies have shown that moderate ozone exposure may impair the ability of individuals with asthma or respiratory disease to engage in normal daily activities. Roughly, one out of every three people in the United States is at a higher risk of experiencing ozone-related health effects. Sensitive people include children and adults who are active outdoors, people with respiratory disease, such as asthma, and people with unusual sensitivity to ozone. People of all ages who are active outdoors are at increased risk because, during physical activity, ozone penetrates deeper into the parts of the lungs that are more vulnerable to injury. Ozone can inflame and damage the lining of the lungs. Within a few days, the damaged cells are shed and replaced—much like the skin peels after sunburn. Animal studies suggest that if this type of inflammation happens repeatedly over a long time period (months, years, a lifetime), lung tissue may become permanently scarred, resulting in less lung elasticity, permanent loss of lung function, and a lower quality of life. Moreover, ozone has been found to be responsible for agricultural crop yield loss in the U.S. and has caused noticeable foliar damage to many crops and species of trees. According to the EPA, forest and ecosystem studies indicate that damage is resulting from current ambient ozone levels.

The 8-hour ozone standard is the fourth highest 8-hour average greater than 0.075 ppm. It was lowered from 0.085 to 0.075 effective May 27, 2008. If the three year average of the fourth highest reading is greater than 0.075 the area will be non-attainment. This applies to each site in the area.

There were two ozone-monitoring sites in Miami-Dade County during 2009. A central site, at the University of Miami's Rosenstiel School, is located along the Rickenbacker Causeway near the Miami Seaquarium. The southern site, at Perdue Medical Center, is located in the Cutler Bay area. These sites are equipped with wind speed and wind direction (WS/WD) equipment.

The maximum one-hour readings for ozone in Miami-Dade County during calendar year 2009 were: 0.096 ppm at the Rosenstiel (RS) site and 0.095 ppm at the Perdue (PR) site. Over 96 percent of the readings were less than or equal to 0.055 ppm at both sites. Figure 2 indicates the maximum hourly average concentrations of ozone for each month compared to the old one-hour standard of 0.12 parts per million (ppm). The yearly average concentration of ozone was 0.031 ppm for Rosenstiel and 0.026 ppm for Perdue. There were no violations of the old one-hour ozone standard during 2009.

Rosenstiel and Perdue both had one 8-hour average concentration greater than 0.075 ppm in 2009. This is in the "Unhealthy for Sensitive Groups" AQI range. Rosenstiel's and Perdue's maximum 8-hour average were the same, 0.076 ppm on 4/16/09. Both had an AQI of 101. Rosenstiel's other high readings were 0.073 ppm on 4/08/09 and 4/22/09 (AQI 93). Perdue's other high readings were 0.072 ppm (AQI 90) on 4/22/09 and 0.068 ppm (AQI 77) on 4/8/09. The fourth highest 8-hour average at Rosenstiel was 0.064 ppm on 4/23/09 (AQI 64) and at Perdue 0.062 ppm on 4/09/09 (AQI 58). Both were in the "Moderate" AQI range. In order for the site to be considered in attainment, the three-year average of the fourth highest 8-hour average must be less than 0.075 ppm. The three-year attainment averages were: Rosenstiel 0.068 ppm and Perdue 0.069 ppm. Both sites are in attainment.

The average 8-hr monthly ozone concentration exhibited a similar pattern at all sites. The higher months were in the spring with April being the highest month. The lower months were in the summer with August being the lowest. The 1-hour and 8-hour maximum monthly ozone concentrations occurred in April at Rosenstiel and Perdue. The early morning hours (7:00 a.m. and 8:00 a.m. (EST)) have the lowest readings for ozone levels. However, it increased to a peak between 1:00 p.m. and 3:00 p.m. (EST) followed by a subsequent decrease. This is the normal daily pattern for ozone.

The Air Quality Indexes at Perdue were in the "Good" range for 357 days, the "Moderate" range for 5 days, the "Unhealthy for Sensitive" Groups range for 1 day and there were 2 days without data. The Air Quality Indexes at Rosenstiel were in the "Good" range for 356 days, the "Moderate" range for 7 days, the "Unhealthy for Sensitive Groups" range for 1 day and there was 1 day without data.

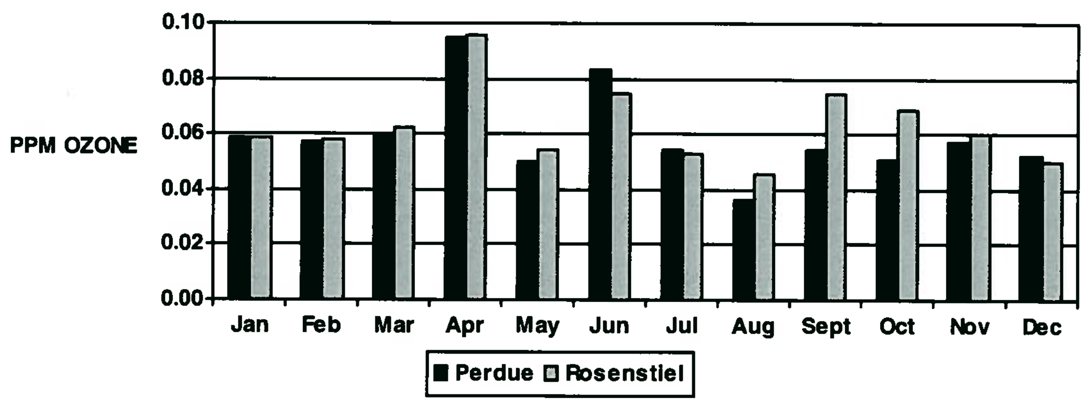


Figure 2. 1-Hour Maximum Monthly Ozone Concentrations – 2009

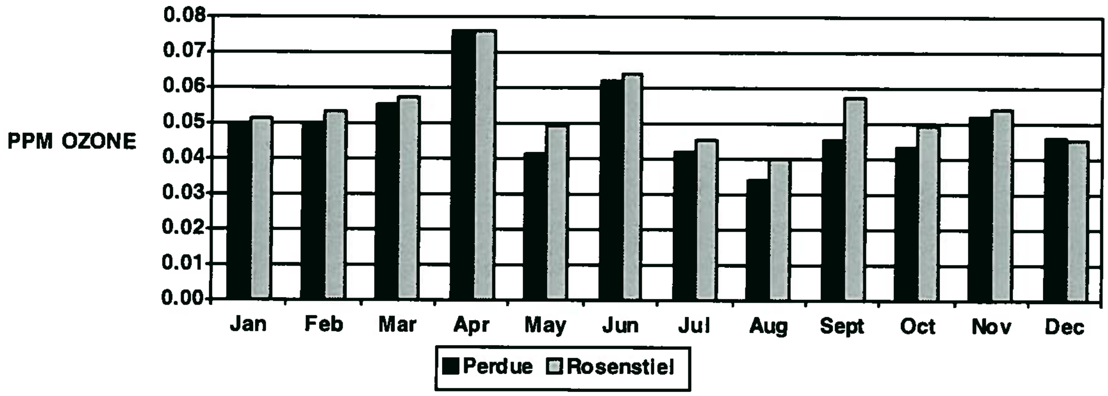


Figure 3. 8-Hour Maximum Monthly Ozone Concentrations – 2009

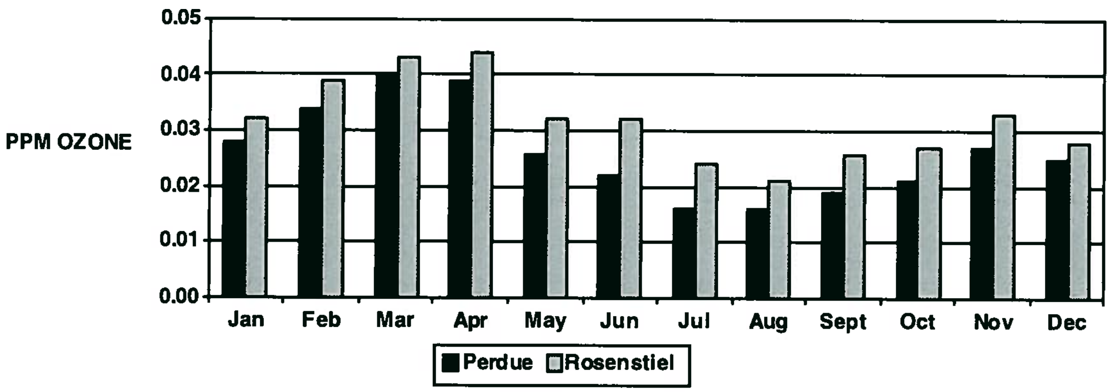


Figure 4. Average 8-Hour Monthly Ozone Concentrations – 2009

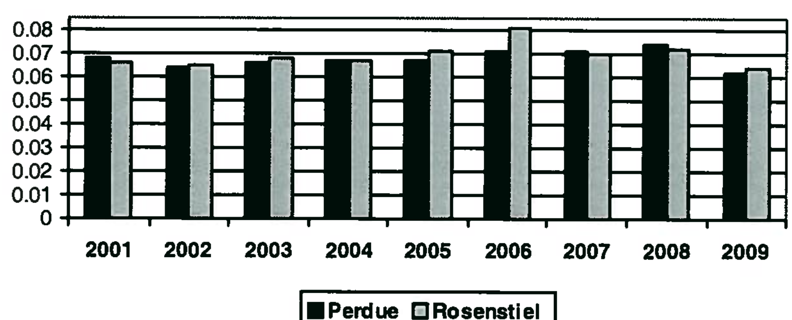


Figure 5. 4th Highest 8-Hour Average Ozone Concentrations

CARBON MONOXIDE (CO)

Carbon Monoxide (CO) is an odorless, colorless, poisonous gas that is a by-product of incomplete combustion of fuels. Vehicle exhaust is the main source of carbon monoxide in the atmosphere with industrial processes, solid waste facilities, electrical power generating plants and natural sources such as wildfires contributing the rest. Vehicles contribute approximately 60 percent nationwide and up to 95 percent in the urban areas. Unlike ozone, carbon monoxide pollution is localized and found mainly along major roads and intersections due to vehicular traffic.

After carbon monoxide is inhaled, it enters the bloodstream and binds chemically to hemoglobin, the substance that normally carries oxygen to cells. The decrease in available, unbound hemoglobin results in a reduction of oxygen delivered to all tissues in the body. Carbon monoxide also weakens the contractions of the heart, thereby reducing the amount of blood and oxygen supplied to various parts of the body. In a healthy person, this effect significantly reduces the ability to perform exercises. In persons with chronic heart disease, these effects can threaten the overall quality of life, since their systems are unable to cope with the decrease in oxygen. Adverse effects have been observed in individuals with heart conditions who are exposed to carbon monoxide.

At relatively low concentrations (several hours @ 200 ppm), carbon monoxide can affect mental function, visual acuity and alertness of healthy individuals. Symptoms include dizziness, headaches and lethargy. Exposure to higher carbon monoxide concentrations (30 minutes @ 2000-2500 ppm) can ultimately lead to death. Death results from asphyxiation because body tissues, especially the brain, are deprived of an adequate oxygen supply. Concentrations of carbon monoxide normally encountered in urban environments are usually a small fraction of these levels.

The NAAQS primary carbon monoxide one-hour standard is 35 ppm; the eight-hour standard is 9 ppm. More than one exceedance of the carbon monoxide standard in any year could result in a non-attainment designation for carbon monoxide.

Four carbon monoxide monitoring sites were active in Miami-Dade County during 2009. The northernmost site, the Lab/Annex site, is located northwest of Downtown Miami, west of I-95 and north of SR 836. The second site, located at a School Board building, is approximately 2 miles west of the Downtown area. The third site, Coral Reef, is located along the Palmetto Golf Course near the intersection of SW 160th Street and US 1. The fourth site, Kendall, is located on Kendall Drive and SW 127 Avenue.

The maximum hourly readings in Miami-Dade County during 2009 were 2.9 ppm for the Lab/Annex site (LB), 3.2 ppm for the School Board (SB) site, 1.9 ppm for the Coral Reef (CR) site and 2.0 ppm for the Kendall site (KN). 100% of the 1-hour readings were less than 3.0 ppm at the Lab/Annex, Coral Reef and Kendall sites and more than 99.9% of the 1-hour readings at the School Board site were less than 3.5 ppm. Maximum 8-hour readings were 2.3 ppm for the Lab/Annex, 1.8 ppm for the School Board, 1.4 ppm for the Coral Reef site and 1.8 ppm for the Kendall site. There were no exceedances of the 1-hour or 8-hour standards for carbon monoxide during 2009. The yearly average concentration of carbon monoxide in Miami-Dade County during 2009 was 0.41 ppm for the Lab/Annex, 0.55 ppm for the School Board, 0.51 ppm for the Coral Reef site and 0.48 ppm for the Kendall site.

While an average monthly carbon monoxide pattern was not evident at any site, the Lab/Annex, School Board, Coral Reef and Kendall sites exhibited a similar daily pattern of hourly readings. Carbon monoxide concentrations were generally low, with a noticeable increase then decrease from 5:00 a.m. to 10:00 a.m. with a peak at 7:00 or 8:00 a.m. (EST), which coincided with commuter rush-hour traffic.

The Air Quality Index for all sites was in the "Good" range for 2009.

PARTICULATE MATTER (PM10 / PM2.5)

Air pollutants called Particulate Matter (PM) (particles) include soot, dust, dirt, fly ash and small liquid drops in air (mists). Particulate matter sources include factories, power plants, cars, construction activity, fires and wind. Particulate matter also includes particles formed in the atmosphere by condensation or transformation of emitted gases such as SO_2 and VOCs.

Particles with an aerodynamic diameter of 10 micrometers or less (PM10) pose the greatest threat to human health, because they can be inhaled into and accumulate in the respiratory system. Particles less than 2.5 micrometers in diameter are referred to as "fine" particles. Sources of fine particles include all types of combustion (motor vehicles, power plants, wood burning, etc.) and some industrial processes. Particles with diameters between 2.5 and 10 micrometers are referred to as "coarse." Sources of coarse particles include crushing or grinding operations, and dust from paved or unpaved roads.

Both fine and coarse particles can accumulate in the respiratory system and are associated with numerous health effects. Coarse particles can aggravate respiratory conditions such as asthma. Exposure to fine particles is associated with several serious health effects, including premature death. Adverse health effects have been associated with exposures to PM over both short periods (such as a day) and longer periods (a year or more).

Based on studies of human populations exposed to high concentrations of particles (often in the presence of sulfur dioxide) and laboratory studies of animals and humans, the major effects of concern for human health include effects on breathing and respiratory systems, aggravation of existing respiratory and cardiovascular diseases, alterations in the body's defense systems against foreign materials, damage to lung tissue, carcinogenesis and premature mortality. The major subgroups of populations that appear likely to be most sensitive to the effects of particulate matter include individuals with chronic obstructive pulmonary or cardiovascular disease, individuals with influenza, asthmatics, the elderly and children. Particulate matter causes soiling and damage to materials, and is a major cause of substantial visibility impairment in many parts of the U.S. When exposed to particles, people with existing heart or lung diseases—such as asthma, chronic obstructive pulmonary disease, congestive heart disease, or ischemic heart disease—are at increased risk of premature death or admission to hospitals or emergency rooms. The elderly also are sensitive to PM exposure. They are at increased risk of admission to hospitals or emergency rooms and premature death from heart or lung diseases. When exposed to particles, children and people with existing lung disease may not be able to breathe as deeply or vigorously as they normally would, and they may experience symptoms such as coughing and shortness of breath. Particles can increase susceptibility to respiratory infections and can aggravate existing respiratory diseases, such as asthma and chronic bronchitis, causing more use of medication and more doctor visits.

During 1988, the EPA changed the then current TSP standard to a more restrictive PM10 standard, specifically 150 micrograms per cubic meter ($\mu g/m^3$) over any 24-hour period. The annual arithmetic mean PM10 standard was 50 $\mu g/m^3$. The EPA allows only one exceedance of the 24-hour standard per calendar year. The later amendments added PM2.5 standards to the PM10 standards and removed the annual arithmetic mean PM10 standard (12/17/2006). This was done because of a lack of evidence linking health problems to long-term exposure to coarse particulate pollution. The PM2.5 standards were 65 micrograms per cubic meter ($\mu g/m^3$) over any 24-hour period and annual arithmetic mean PM2.5 standard of 15 $\mu g/m^3$. To attain the annual arithmetic mean standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 15.0 $\mu g/m^3$. As of December 17, 2006, the PM2.5 Daily standard was lowered to 35 ug/m^3. To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$. The Air Quality Index was upgraded to the 35 ug/m^3 standard from the old 65 ug/m^3 standard late in 2008. The AQI used for this report is based on the new standard.

There is one active PM10 monitoring site in Miami-Dade County in 2009. The Miami Fire station (MF) site near the Santa Clara Metrorail station is the only active PM10 site.

The maximum daily reading for PM10 in Miami-Dade County during 2009 was 76.00 $\mu g/m^3$, with most of the daily readings ranging between 15 to 35 $\mu g/m^3$. The annual arithmetic mean was 23.17 $\mu g/m^3$. There were no daily exceedances.

There were three active PM2.5 24-hour monitoring sites in Miami-Dade County during 2009. The 24-hour samplers run from midnight to midnight Eastern Standard Time. The Miami Fire Station (MF) site, near the Santa Clara Metrorail station, and the Homestead Fire Station (HF) site have daily 24-hour samplers (FRM). The Palm Springs Fire Station (PS) site has a 24-hour sampler that samples every third day.

The maximum daily reading for PM2.5 during 2009 occurred on the July 4th at the Homestead Fire Station with a value of 34.50 $\mu g/m^3$. Precipitation during the fireworks also caused the 24-hour concentration of 16.4 $\mu g/m^3$ at the Miami Fire Station to be lower than usual. Also, there was no exceedance due to the aforementioned reason during the January 1st fireworks. In addition, the maximum daily reading for Palm Springs was 14.2 $\mu g/m^3$ and 19.3 $\mu g/m^3$ for the Miami Fire Station which occurred on July 30, 2009. In summary, more than 98 % of the daily readings were less than or equal to 15 $\mu g/m^3$ for all sites except for Palm Springs which was approximately 91%. The annual arithmetic mean was 6.44 $\mu g/m^3$ at the Homestead Fire Station, 7.51 $\mu g/m^3$ at the Miami Fire Station and 6.38 $\mu g/m^3$ at the Palm Springs Fire Station. There were no annual arithmetic mean exceedances.

The Air Quality Indexes for Homestead Fire Station FRM had 358 days in the "Good" range, 3 days in the "Moderate" range, no days in the "Unhealthy for Sensitive Groups" range, and there were 3 days with no data. The Air Quality Indexes for Miami Fire Station FRM had 348 days in the "Good" range, 6 days in the "Moderate" range, no days in the "Unhealthy for Sensitive Groups" and there were 11 days with no data. The Air Quality Indexes for Palm Springs Fire Station FRM had 113 days in the "Good" range, no days in the "Moderate" and "Unhealthy for

Sensitive Groups" ranges and there were 9 days with no data. Precipitation in celebrated events like the New Year's Eve minimized the formation of particulate matter resulting in AQI values above the "Unhealthy for Sensitive Groups" range. The Palm Springs sampler only operated once every three days. The FRM data is used for the corrected AQI but not to determine the daily AQI because it takes several weeks to obtain the results from the Florida DEP lab.

Continuous PM2.5 analyzers (PM2.5 TEOM) were operated at the Miami Fire Station and the Homestead Fire Station in 2009. Both were used for the daily Air Quality Index because the results are continuously available. The maximum daily reading was 29.4 $\mu g/m^3$ for the Miami Fire Station and 33.1 $\mu g/m^3$ for the Homestead Fire Station. The high value at the former site was due to the Sahara dust impacting South Florida and the latter site was affected the Fourth of July fireworks. The highest 1-hour reading was 104.5 $\mu g/m^3$ at 1000 EST on January 12th at the Miami Fire Station and 178.5 $\mu g/m^3$ at 2100 EST on July 4th at the Homestead Fire Station. The high value on the former site may be source related while the latter site was affected by fireworks. The annual arithmetic mean was 10.29 $\mu g/m^3$ for the Miami Fire Station and 9.31 $\mu g/m^3$ for the Homestead Fire Station. 99.3 % of the 1-hour readings were 30 $\mu g/m^3$ or less at the Miami Fire Station and 99.5% at the Homestead Fire Station. The TEOMs' PM2.5 daily averages are usually higher than the FRMs' corresponding daily concentration.

The Air Quality Indexes for the Miami Fire Station PM2.5 TEOM were 333 days in the "Good" range, 26 days in the "Moderate" range, no days in the "Unhealthy for Sensitive Groups" and there were 6 days with no data. The Air Quality Indexes for the Homestead Fire Station PM2.5 TEOM were 339 days in the "Good" range, 25 days in the "Moderate" range, no days in the "Unhealthy for Sensitive Groups" and there were no days without data.

When the hourly data is averaged for each hour for the year, a noticeable increase then decrease is seen from 5:00 a.m. to 10:00 a.m. with a peak at 7:00 a.m. (EST), which coincided with commuter rush-hour traffic.

SULFUR DIOXIDE (SO_2)

Sulfur dioxide (SO_2) is a colorless, reactive gas that is odorless at low concentrations, but pungent at higher concentrations. It is emitted primarily when fossil fuels and coal that contains sulfur are burned or processed. Major sources of sulfur dioxide are fossil fuel-burning power plants, industrial boilers, refineries, pulp and paper mills, and non-ferrous smelters.

Exposure to sulfur dioxide can cause impairment of respiratory function, aggravation of existing respiratory diseases and a decrease in the ability of the lungs to clear foreign particles. It can also lead to increased mortality, especially if elevated levels of particulate matter are present. Several studies of chronic effects have found that people living in areas with high particulate matter and sulfur dioxide levels have a higher incidence of respiratory illness and symptoms than people living in areas without this synergistic combination of pollutants. Symptoms of sulfur dioxide exposure include wheezing, shortness of breath and coughing.

Sensitive populations include asthmatics, individuals with hyperactive airways, patients with chronic obstructive lung or cardiovascular disease (bronchitis or emphysema), elderly people and children. Sulfur dioxide also produces acid rain that causes foliar damage to trees and agricultural crops.

The air quality standard for sulfur dioxide is 0.14 ppm averaged over 24 hours. The annual arithmetic mean has been set at 0.03 ppm. The three-hour sulfur dioxide standard is 0.50 ppm. The first two sulfur dioxide standards are primary standards while the third (three-hour) is a secondary standard. The annual mean standard is not to be exceeded more than once per year. More than one exceedance of the short-term standard could result in a non-attainment designation for sulfur dioxide. It should be noted that both the State of Florida and Metropolitan Miami-Dade County have set sulfur dioxide standards that are more stringent than the NAAQS. These standards are included in Table 1.

One sulfur dioxide site was active in Miami-Dade County in 2009. The sole SO_2 site (PN) is located in Pennsuco at the northeast corner of State Road 821 and State Road 27.

During calendar year 2009, the annual arithmetic mean of sulfur dioxide in Miami-Dade County was 0.0000 ppm, the maximum 24-hour average was 0.001 ppm, the maximum 3-hour average was 0.006 ppm and the highest 1-hour concentration was 0.012 ppm. Ninety-nine percent of the readings were less than 0.001 ppm. There were no SO_2 exceedances of federal, state or Miami-Dade County standards during 2009. Due to the low concentrations, sulfur dioxide was not used in the air quality index.

NITROGEN DIOXIDE (NO_2)

Nitrogen dioxide (NO_2) is a light brown gas that contributes to urban haze. Nitrogen oxides are produced because of high temperature combustion processes, such as those occurring in automobiles, power plants, home heaters and gas stoves.

Nitrogen dioxide can irritate the lungs, lower resistance to respiratory infection, such as influenza, and place a strain on the heart. The effects of short-term exposure are still unclear but continued or frequent exposure to concentrations higher than those normally found in the ambient air may cause increased incidence of acute respiratory disease in children. Another concern is that nitrogen dioxide contributes to the formation of ozone as well as acidic precipitation (acid rain).

Two nitrogen dioxide monitors were active in Miami-Dade County during 2009. The northernmost site, the Lab/Annex site, is located northwest of Downtown Miami, west of I-95 and north of SR 836. The second site, at University of Miami's Rosenstiel School, is located along the Rickenbacker Causeway near the Seaquarium

The annual arithmetic mean air quality standard (EPA) for nitrogen dioxide is 0.053 ppm (53 ppb). During calendar year 2009, the annual arithmetic mean concentrations for Miami-Dade County were 0.009 ppm at the Lab/Annex (LB) site and 0.003 ppm at the Rosenstiel (RS) site. Over 99 percent of the readings at both sites were less than or equal to 0.035 ppm. The maximum hourly reading for the Lab/Annex site was 0.043 ppm. The Rosenstiel site's maximum hourly reading was 0.049 ppm. The average hourly nitrogen dioxide pattern was the same at both sites, with a significant increase starting at 5-6:00 a.m. EST and ending at 11-12:00 a.m., with a peak occurring around 7:00 a.m. EST at the Lab site and 8:00 a.m. EST at the Rosenstiel site. There were no nitrogen dioxide exceedances in Miami-Dade County during 2009. Nitrogen dioxide was not used in the air quality index.

LEAD (Pb)

Historically, the major source of Lead (Pb) in the atmosphere has been due to combustion of leaded gasoline in motor vehicles. With the phase-out and complete ban of leaded gasoline, the already low levels of Pb decreased steadily to below detectable levels in Miami-Dade County in 1991, as can be seen in Figure 6. Other potential airborne lead sources include aviation fuel containing lead, municipal waste combustors, battery plants, lead processing or secondary lead smelting operations. Airborne lead can enter the body through inhalation; ingestion of food products or drinking water contaminated with lead particle deposits. Upon entering the body, lead can be absorbed in the bloodstream and distributed throughout the body where its toxic effects can cause damage. Sensitive organs and systems include the blood, brain and nervous system, the kidneys, liver and reproductive systems.

Young children are particularly at risk because the adverse health effects occur at lower lead levels than found in the average adult. Moreover, children are more likely to be exposed through the ingestion of soils and dust containing lead as a result of playing in heavily urbanized or industrialized settings and by ingestion of old paint containing lead. Studies have suggested that learning disabilities and lower IQs can occur in children having elevated lead levels in the blood. Recent studies have also shown that lead may be a factor in high blood pressure and subsequent heart disease in some middle-aged males.

The NAAQS Lead standard was set at a maximum quarterly average of 1.5 micrograms per cubic meter ($\mu g/m^3$) until October 15, 2008 when it was changed to 0.15 micrograms per cubic meter ($\mu g/m^3$).

There were two lead sites in Miami-Dade County. One site was located at Hialeah High School (HS) and the other was located west of the Palmetto Expressway South of West Flagler Street (PL). Both sites were closed on October 31, 1996. With the new standard, Miami-Dade County is not required to sample for lead.

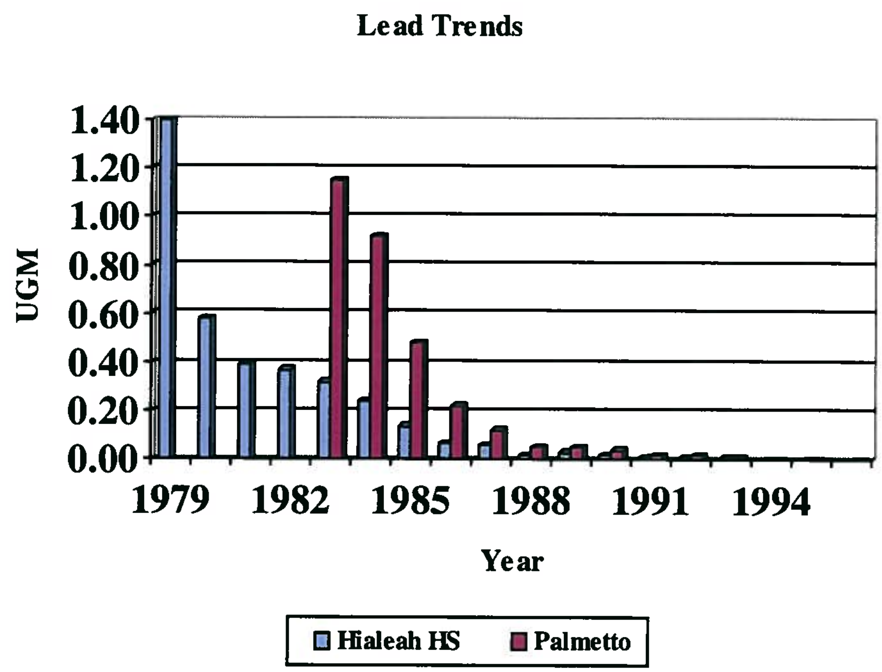


Figure 6. Lead Trends 1979 to 1996

DAILY AIR INDEX or AIR QUALITY INDEX (AQI)

The Air Quality Index (AQI) was developed by the EPA to provide accurate and easily understandable information to the community about daily air pollution levels and the associated health effects. The Index provides EPA with a uniform system of associating pollution levels for the major air pollutants (particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide and ground-level ozone) regulated under the Clean Air Act (CAA) with the appropriate health concerns. The AQI is reported in all metropolitan areas of the United States with populations exceeding 200,000. The AQI figures also enable the public to determine whether air pollution levels for the day in Miami-Dade County in the "Good", "Moderate", "Unhealthy for Sensitive Groups" or worse category. The AQI converts each measured pollutant's concentration in a community's air to a number on a scale of 0 to 500 to which a category and color is assigned. Each category corresponds to a different level of health concern.

The six categories / levels of health concern are:

"Good" The AQI value for your community is between 0 and 50. Air quality is considered satisfactory and air pollution poses little or no risk.

"Moderate" The AQI for your community is between 51 and 100. Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of individuals. For example, people who are unusually sensitive to ozone may experience respiratory symptoms.

"Unhealthy for Sensitive Groups" AQI values are between 101 and 150. Certain groups of people are particularly sensitive to the harmful effects of certain air pollutants. This means they are likely to be affected at lower levels than the general public. For example, children and adults who are active outdoors and people with respiratory disease are at greater risk from exposure to ozone, while people with heart disease are at greater risk from carbon monoxide and people with either heart or lung disease are at risk from particulates. Some people may be sensitive to more than one pollutant. The general public is not likely to be affected when the AQI is in this range.

"Unhealthy" AQI values are between 151 and 200. Everyone may begin to experience health effects. Members of sensitive groups may experience more serious health effects.

"Very Unhealthy" AQI values between 201 and 300 trigger a health alert, meaning everyone may experience more serious health effects.

"Hazardous" AQI values over 300 trigger health warnings of emergency conditions. The entire population is more likely to be affected.

The actual concentrations that govern the categories / levels of health concerns have changed several times over the years in response to the different parameters standard being lowered. In 2007, the ozone concentration was lowered and in 2008 the PM2.5 concentration was lowered.

The information above and the present concentration ranges are in Table 3 below.

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	*...air quality conditions are:*	*...as symbolized by this color:*
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0-50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51-100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101-150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151-200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201-300	Health alert: everyone may experience more serious health effects.
Hazardous	> 300	Health warnings of emergency conditions. The entire population is more likely to be affected.

AQI Level	Numerical Value	Ozone	PM2.5	Carbon Monoxide
Good	0-50	0-59 ppb	0-15.4 $\mu g/m^3$	0-4.4 ppm
Moderate	51-100	60-75 ppb	15.5-35.4 $\mu g/m^3$	4.5-9.4 ppm
Unhealthy for Sensitive Groups	101-150	76-95 ppb	35.5-65.4 $\mu g/m^3$	9.5-12.4 ppm
Unhealthy	151-200	96-115 ppb	65.5-150.5 $\mu g/m^3$	12.5-15.4 ppm
Very Unhealthy	201-300	116-375 ppb	150.5-250.4 $\mu g/m^3$	15.5-30.4 ppm
Hazardous	>300	>375 ppb	>250.5 $\mu g/m^3$	>30.5 ppm

Table 3. AQI Information

The AQI is determined on weekdays using all of the operational carbon monoxide, ozone, nitrogen dioxide, sulfur dioxide and continuous particulate (PM2.5 TEOM) monitors. Although the data for nitrogen dioxide and sulfur dioxide is collected, neither has ever been high enough to be used as the basis for calculating the AQI. Ozone and PM2.5 are the pollutants that are usually the governing pollutant for the AQI. The highest AQI value of all the pollutants up to 3:00 pm is reported at about 3:30 pm. At the same time, the air quality for the next day is forecast. The AQI for the day is available by calling DERM's Air Quality Management Division at 305-372-6925 or by going to http://www.miamidade.gov/derm/air_quality_today.asp. The forecast is available on the same website after midnight. After 4:00 pm, an email with the next day's forecast is automatically sent to subscribers to EPA's EnviroFlash. To subscribe to EPA's EnviroFlash go to http://miamidade.enviroflash.info,

For more information about the air quality index, the current (hourly) AQI for ozone and PM2.5 for Miami-Dade County and other areas of the country and the air quality forecast for the next day, visit EPA's AIRNow web site at http://airnow.gov/.

After all the monitoring data for the month is corrected and verified, a corrected AQI is calculated for every day of the month using all air monitoring sites with the 24-hour PM2.5 (FRM) samples being used instead of the PM2.5 TEOM values.

Historically, the AQI has never registered higher than "Unhealthy for Sensitive Groups" in Miami-Dade County. The AQI registered as "Unhealthy for Sensitive Groups" four days in 1989, one day in 1990, two days in 1991, one day in 1996, one day in 1998, four days in 1999, one day in 2001, one day in 2003, three days in 2004, one day in 2006 and one day in 2007. In 2008, there were four days for ozone and one day for PM2.5. In 2009, there was one day for ozone.

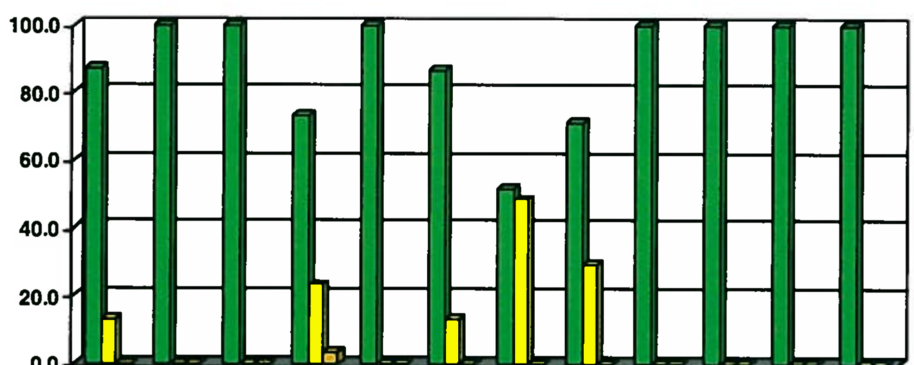
The AQI value was reported as "Unhealthy for Sensitive Groups" during 1989 when uncontrolled wildfires in the Everglades National Park produced significant pollution, which aggravated respiratory problems for some citizens of Miami-Dade and neighboring counties. In May 1998, the Florida Department of Environmental Protection issued the first Florida statewide air advisory. This was because of air pollution caused by massive wild fires in Central America. The pollution plume had a detrimental effect on the air quality in the Southeastern United States. In May and June 2007, smoke plumes from wildfires in Georgia and Florida caused poor air quality in Miami-Dade County and across Florida. The increase in 2008 was caused by the lower standards concentration for both ozone and PM2.5 that took effect in 2008. Smoke warnings are issued when smoke from wildfires in the county, the Everglades and else where in Florida have a serious impact on the air quality even if the AQI does not get above "Moderate" levels. In 2009, the high ozone AQI level was due to the effects of a hot sunny clear skies, dry conditions, and light winds limiting vertical mixing and thus trapping pollutants near the surface.

Analysis of recorded AQI data for Miami-Dade County demonstrates that air quality has been good the last ten years, with the percentage of Good days varying from 86.8% to 94.5 %, with Moderate days varying from 5.2% to 13.2% and Unhealthy for Sensitive Groups days varying from 0.0% to 1.4%. In 2008, the percentage of days with "Unhealthy for Sensitive Groups" AQI increased to 1.4% because of the lowering of the standards for Ozone and PM2.5. However, in 2009 the percentage was lowered to 0.3%. Table 4 lists Miami-Dade's AQI data for 2009 as the number of days in AQI parameter and Air Quality range. Figure 7 shows the monthly percentage of Good, Moderate and Unhealthy for Sensitive Groups days for 2009. Figure 8 shows the trend of Good, Moderate and Unhealthy for Sensitive Groups days since 2000.

AQI / Parameter	Number Of Days Total in 2009
Good (0 to 50)	**325**
Ozone (O_3)	182
Carbon Monoxide (CO)	0
Particulate Matter (PM2.5)	143
Moderate (51 to 100)	**39**
Ozone (O_3)	7
Carbon Monoxide (CO)	0
Particulate Matter (PM2.5)	32
Unhealthy For Sensitive Groups (101 to 150)	**1**
Ozone (O_3)	1
Carbon Monoxide (CO)	0
Particulate Matter (PM2.5)	0

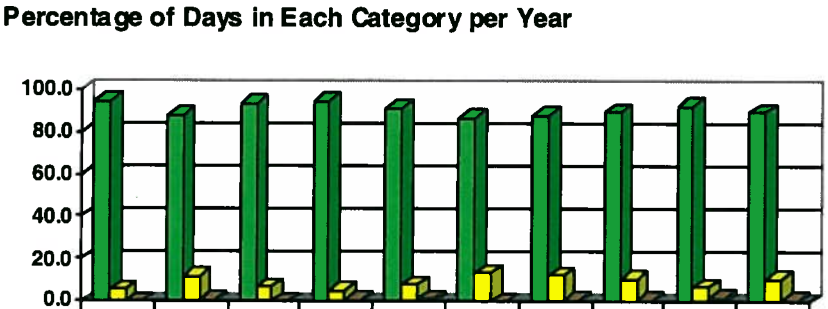
Table 4. AQI Parameters for 2009

PERCENT AIR QUALITY INDEX BY MONTH



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Good	87.1	100.0	100.0	73.3	100.0	86.7	51.6	71.0	100.0	100.0	100.0	100.0
Moderate	12.9	0.0	0.0	23.3	0.0	13.3	48.4	29.0	0.0	0.0	0.0	0.0
Unhealthy for Sensitive Groups	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 7. Monthly AQI Breakdown for 2009



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Good	94.3	87.9	93.2	94.5	91.2	86.8	87.7	89.3	92.0	89.0
Moderate	5.7	11.8	6.8	5.2	7.9	13.2	12.0	10.4	6.6	10.7
Unhealthy for Sensitive Groups	0.0	0.3	0.0	0.3	0.9	0.0	0.3	0.3	1.4	0.3

Figure 8. AQI Trend, FY 1999-2009

The comparison of the AQI over the last ten years (2000 to 2009) in Table 5 shows that the air quality in Miami-Dade County has remained constant with the percentage of Unhealthy for Sensitive Groups days being very small and over 80 percent of every year being in the Good range. In 2001, the particulate sampled changed from being PM10 (Particulate Matter less than 10 microns) to being PM2.5 (Particulate Matter less than 2.5 microns) with a change in the Air Quality Standards for the PM2.5. This resulted in a shift from a final AQI based primarily on ozone (86 to 96 %) to one based on ozone (48 to 63 %) and particulates (37 to 48 %) from 2001 to 2006. With the lowering of the ozone concentrations, the AQI shifted to ozone (69 to 75%) to particulates (25 to 31%) in 2007 and 2008. In 2009, the AQI was slightly higher for ozone (52.1%) compared to particulates (48%). Miami-Dade County was highly affected by the Sahara Dust effect that usually occurs during the month of July thru August.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
% Good (0 to 50)										
O3	82.2	49.9	62.2	46.8	47.0	45.5	53.4	65.5	71.0	49.9
CO	0.0	1.4	0.0	11.5	12.8	0.8	0.3	0.0	0.0	0.0
PM	12.0	36.7	31.0	36.2	31.4	40.5	34.0	23.8	21.0	39.2
% Moderate (51 to 100)										
O3	4.8	3.6	1.1	1.6	1.1	5.2	5.8	3.8	3.0	1.9
CO	0.0	0.3	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
PM	1.1	7.9	5.8	3.6	6.0	7.9	6.3	6.6	3.6	8.8
% Unhealthy for sensitive groups (101 to 150)										
O3	0.0	0.3	0.0	0.3	0.3	0.0	0.3	0.0	1.1	0.3
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PM	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.3	0.3	0.0

Table 5. Percent Annual Total by Parameter and Air Quality

LOCAL CLIMATOLOGICAL DATA

Table 5 lists the ambient temperatures, rainfall amounts and wind directions recorded at the Miami International Airport during 2009.

Month	Temperature, degrees Fahrenheit			Inches	Wind
	Minimum	Maximum	Average	Rainfall	Direction
January	42	86	67.6	0.34	34
February	38	85	68.1	0.12	07
March	47	88	72.7	1.78	09
April	54	92	77.0	1.17	08
May	69	92	80.6	7.53	11
June	71	98	83.5	11.64	13
July	74	95	85.0	6.17	14
August	74	94	85.4	7.91	11
September	75	94	83.9	6.83	09
October	59	94	82.4	2.62	09
November	52	89	75.8	2.97	10
December	49	89	73.0	3.01	33

Table 6. 2009 Local Climatological Data - Miami International Airport

ADDITIONAL INFORMATION

Information on the other counties in Florida can be found at
http://www.dep.state.fl.us/air/air_quality/airdata.htm