Ξ

nyc.gov > Health > EH Data Portal



Environment & Health Data Portal

Home > Data Features > The New York City Community Air Survey

# The New York City Community Air Survey



## NYCCAS Report: 2008-2023

In 2007, the New York City Department of Health and Mental Hygiene (Health Department) established the New York City Community Air Survey (NYCCAS), the largest ongoing urban air monitoring program of any U.S. city. NYCCAS, which began collecting data in December 2008, is a collaboration between the Health Department and Queens College of the City University of New York and provides data to:

- Help inform PlaNYC, the City's sustainability plan
- Track changes in air quality over time
- Estimate exposures for health research
- Inform the public about local topics, such as recent air quality improvements, car-free zones, changes in the sources of air pollution, unique air quality studies conducted in New York City, efforts to reduce health impacts, public health benefits of public transit and differences in air quality and related health impacts across NYC neighborhoods. NYCCAS also

Q

developed a tool (ZAPPA) that can help people understand how policy changes can change local emissions.

#### This report:

- Provides a summary of key findings, the air monitoring program, monitoring site selection, and descriptions of the pollutants measured
- Describes the trends in air pollutant levels from more than a decade of data from winter 2008-2009 through fall 2023 for fine particulate matter, nitrogen dioxide, nitric oxide, black carbon, wintertime sulfur dioxide, and summertime ozone
- Presents maps of neighborhood air pollution levels by year
- Identifies the local sources that contribute the most to differences in these pollutants across New York City neighborhoods

### **Key Findings**

**Citywide, annual average levels of four key pollutants have gone down between the first year of monitoring, 2009, and the most recent year of data, 2023.** During late spring and summer 2023, wildfire smoke from Canada caused an increase in measurements of fine particles (PM<sub>2.5</sub>), including Black Carbon (BC). However, the 2023 levels of these pollutants still represent a decrease from levels when monitoring began in 2009.

- Fine particles -29%
- Nitrogen Dioxide (NO<sub>2</sub>) -38%
- Nitric Oxide (NO) -60%
- Sulfur Dioxide (SO<sub>2</sub>) -98%

Air quality improved significantly after local regulations required building owners to convert to cleaner heating oils by 2015. These heating oils were a major source of SO<sub>2</sub> in New York City. In 2023, only one of our 84 sites detected any SO<sub>2</sub>, and the level at that site was similar to SO<sub>2</sub> levels measured on Whiteface Mountain in the Adirondack Mountains, demonstrating the success of the clean heating oil requirements.

Ozone (O<sub>3</sub>) levels were higher in 2023 than any previous year of NYCCAS monitoring. Ozone is produced when there are oxides of nitrogen (NO<sub>x</sub>) and volatile organic carbon emissions in the presence of sunlight and heat, which is why we see higher levels in the summer. Summer 2023 was one of the hottest in recorded history, likely causing higher O<sub>3</sub> levels.

There has not been a consistent trend in  $O_3$  levels over the history of NYCCAS monitoring, but we may expect  $O_3$  levels to trend higher in the future with further increases in average temperatures due to climate change.

#### Air quality changes with location.

PM<sub>2.5</sub>, NO<sub>2</sub>, NO, and BC are highest in:

- · Areas with higher density of commercial cooking grills and charbroilers
- Industrial areas, specifically areas with higher density of warehouses
- Areas of higher traffic density

- Areas with higher building density
- $O_3$  levels are highest in:
  - Areas with lower vehicle emissions

## Methods

The NYC Health Department designed NYCCAS to understand how average air pollution levels vary from place to place within New York City. NYCCAS staff mount samplers on street light poles 10 to 12 feet off the ground along residential and commercial streets and in parks. The monitors use a small battery-powered pump and filters to collect air samples. Our air samplers are deployed at each NYCCAS site once each season and collect data for a two-week period. Samples are collected in all seasons for NO, NO<sub>2</sub>, PM<sub>2.5</sub> and BC; in the summer for O<sub>3</sub>; and in the winter for SO<sub>2</sub>. For more details on sample collection methods, see Appendix 1 (PDF).

The New York State Department of Environmental Conservation also has a network of 16 air quality monitors in New York City that are required by the federal government, but they are mounted on building roofs. We placed our air samplers at street level to measure pollution where people spend time, and where traffic-related pollution levels are usually higher.

NYCCAS has also deployed eight monitors that can measure  $PM_{2.5}$  levels in real time. These monitors allow us to monitor air pollution as it changes based on the time of day, weather or due to local pollution sources, such as heavy-duty trucks. Get data on realtime air quality.

### **Pollutants Measured**

Fine Particles	+
Black Carbon	+
Nitrogen Dioxide and Nitric Oxide	+
Ozone	+
Sulfur Dioxide	+

#### NYC Community Air Survey Annual Report

## **NYCCAS Sites**

The monitoring locations represent a wide variety of New York City environments – sidewalks, busy streets, parks and quiet neighborhood roads. Most of the sites (80%) were chosen by the NYC Health Department to ensure representation in all types of neighborhoods, including residential, commercial and industrial areas.

The locations vary in the density of traffic and buildings, as well as other environmental differences. The remaining sites were selected because they are near potentially highemission locations that were not captured initially. These include the Hunts Point Market, the Port Authority Bus Terminal and the entrance to the Lincoln Tunnel. The number of sites has changed over the years as we have learned about air quality in our city.

In 2023, we monitored 73 routine locations and an additional 11 sites in low-income neighborhoods that benefit from additional monitoring to understand potential sources of emissions. We refer to these 11 sites as Environmental Justice Sites, in green on the map, and enhance our monitoring with their data when resources are available. Read more about monitoring at Environmental Justice Sites.



## **Pollutant Maps**

Since it is impossible to sample the air in every location in New York City, we monitor representative sites to determine how pollution levels vary in relation to traffic, buildings, trees and other neighborhood factors. We use NYCCAS monitoring data along with data on land use, traffic, building emissions and other neighborhood



factors around the monitors to build a model. This model is used to predict average air pollution levels at locations across the city, including places where no NYCCAS measurements were collected. For more details on emission source data, see Appendix 1 (PDF). For more details on the analysis methods, see NYCCAS Scientific Publications. 4/22/25, 1:23 PM

#### NYC Community Air Survey Annual Report

In the maps below, you can select a pollutant to see how air pollution is distributed throughout the city and how it has changed over time. The city's air quality has changed significantly since NYCCAS began monitoring, as can be seen in the maps below. The levels of BC, NO<sub>2</sub>, NO, SO<sub>2</sub> and PM<sub>2.5</sub> have been significantly reduced citywide. The areas where we see the highest levels of these pollutants has also shifted.

Over time, there are better data available for us to understand the relationships between land use and pollution, and the air pollution patterns have shifted as the city changes. Although industrial land use has been a primary indicator of BC, NO, NO<sub>2</sub> and PM<sub>2.5</sub> pollution in the past, in the most recent years of data we see evidence that density of warehouses with loading docks better explains the difference in pollution levels between neighborhoods. Areas with a density of warehouses, such as Newtown Creek area in Queens and Brooklyn, near JFK airport, Red Hook/Sunset Park in Brooklyn and Hunts Point in the Bronx, have higher levels of pollution.

There have been too few sites with  $SO_2$  values above the detection limit for us to include data after winter 2017-2018 in these maps and charts.  $SO_2$  levels have gone down dramatically since Local Law 43 of 2010 prohibited the burning of heavy fuel oil (No. 6) in New York City buildings (PDF). Historical maps for  $SO_2$  and other pollutants are available by clicking on the "All years" button below.

Winter and summer average maps for BC, NO<sub>2</sub>, NO and  $PM_{2.5}$  are available in Appendix 2 (PDF).

#### NYC Community Air Survey Annual Report



- Citywide, annual average levels of Black Carbon declined by 49% between 2009 and 2023, an average of 0.05 micrograms per cubic meter per year.
- Across the 15-year period, higher levels were consistently seen near warehouses within industrial areas (reflecting increased truck traffic density) and in areas with higher nearby commercial cooking grills and charbroilers.
- In 2023, seasonal average BC concentrations across NYCCAS monitoring sites ranged from 0.01 to 2.3 micrograms per cubic meter. The highest BC concentrations were likely caused by wildfire smoke, which increased 2023 levels at all sites evenly.

Leaflet | © OpenStreetMap contributors © CARTO

# **Pollutant Trends**

Since monitoring began in New York City, we have seen a decrease in most of the air pollutants we measure. The figure below illustrates how the levels of each air pollutant have changed by season from winter 2008-2009 to fall 2023. During the late spring and summer of 2023, wildfires in Canada impacted air quality over several weeks in New York City. Wildfire smoke is a major source of PM<sub>2.5</sub> and BC and likely the reason for higher concentrations in these seasons compared to other recent seasons. The wildfire smoke events impacted air quality evenly across the city.

Air pollution changes not only by neighborhood, but also by season. Some pollutants are highest in certain seasons of the year because of either weather patterns or emissions sources. For example,  $O_3$  is produced when NO and  $NO_2$  and other airborne pollutants react in the presence of heat and sunlight. Therefore, we only monitor  $O_3$  in the summer when direct sunlight is highest and days are longer.

#### NYC Community Air Survey Annual Report

Decreases in average concentrations of NO<sub>2</sub>, NO and PM<sub>2.5</sub> are not always evenly distributed across the city. For example, neighborhoods with more industrial zones with more diesel truck traffic, neighborhoods with large numbers of restaurants, and areas of higher traffic and building density generally have higher pollutant concentrations than neighborhoods with lower densities of emission sources. In the figure below, you can also choose each pollutant's main sources, and see air pollution for neighborhoods with high, medium, and low density of those emissions sources, as well as the overall annual average for these monitoring locations.



## **Pollutant Predictors**

NYCCAS data were analyzed using a model that estimates associations among pollution levels and land uses, like traffic and zoning, around the monitoring sites. The pollution sources that contribute most to differences in concentrations of NO, NO<sub>2</sub>, BC, and PM<sub>2.5</sub> across NYC are listed in the table below. SO<sub>2</sub> is now so low in NYC that it has not been possible to build a model for SO<sub>2</sub> concentrations since 2018.

Fuel used to provide heat and hot water in buildings has become significantly cleaner under state and local regulations requiring use of cleaner burning fuels. As a result, commercial charbroiling and grilling operations have become a more important source of  $PM_{2.5}$  emissions over the past several years. The number of charbroilers and grills in restaurants in an area now explains  $PM_{2.5}$  and BC differences among neighborhoods better than building emissions. For more

information on these changes, see Tracking changes in New York City's sources of air pollution.

ВС	NO	NO <sub>2</sub>	03	PM <sub>2.5</sub>		
Indicator			Description			Associated sources
Traffic emissions			Area of impervious road surface within 100 meters			Emissions of motor vehicles on paved roadways
Commercial cooking			Number of permitted commercial cooking grills and charbroilers within 100 meters			Emissions from commercial cooking
Building emissions			PM <sub>2.5</sub> emissions from heat and hot water oil-burning boilers in buildings within 100 meters			Combustion of heating oil
Industrial land use		d A	Area wit within 1,	h industri 000 mete	al land-use rs	Emissions from trucks idling and traveling to and from industrial areas; and industrial combustion equipment

# Conclusion

This report underscores the importance of local emissions reduction efforts over the past decade and highlights the continued need to reduce emissions citywide. The City's sustainability plan, PlaNYC, and its roadmap to reduce greenhouse gas emissions, 80x50, have already and will continue to improve air quality, providing important public health benefits to all New Yorkers. These strategies and measures include:

- Reducing emissions from commercial charbroiling through regulations and technical support to restaurants
- Creating low or zero emission freight networks and reducing reliance on trucks
- Improving and expanding public transit
- Getting the most polluting trucks off New York City streets
- Accelerating the phase-out of fossil fuel combustion in buildings, focusing on the communities most impacted by air pollution-related health impacts

Air quality in New York City has greatly improved over the past decade and will continue to improve with efforts to control emissions from the most important sources.

#### **More information**

- Appendix 1 (PDF): Sampling Methodology and Data Sources for Emissions Indicators.
- Appendix 2 (PDF): Seasonal Average Pollutant Maps.
- Appendix 3 (PDF): Community District Average Pollution Levels.
- The Public Health Impacts of PM<sub>2.5</sub> from Traffic Air Pollution data story.
- NYC OpenData: NYCCAS Air Pollution Rasters.
- New York Community Air Survey: past reports

### You might also be interested in:

What our air quality monitors tell us about NYC's neighborhoods

E Real-Time Air Quality: PM2.5 in NYC

Air quality snapshots: special findings from 10 years of NYCCAS

## More related to:

Air quality

© City of New York. 2022 All Rights Reserved, NYC is a trademark and service mark of the City of New York.