Environment & Health Data Portal

The New York City Community Air Survey

NYCCAS Report: 2008-2022

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 and differences in air quality and related health impacts across NYC neighborhoods. NYCCAS also 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 2022 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 to high levels of these pollutants in 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, 2022.

- Fine particles ($PM_{2.5}$) -46%
- Nitrogen Dioxide (NO_2) -41%
- Nitric Oxide (NO) -58%
- Sulfur Dioxide (SO_2) -97%

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_2 in New York City. In 2022, only eight of our 90 sites detected any SO_2, and the levels at those sites were similar to SO_2 levels measured on Whiteface Mountain in the Adirondack Mountains, demonstrating the success of the clean heating oil requirements.

Ozone (O_3) levels were higher in 2022 than any previous year of NYCCAS monitoring. Ozone is produced when there are oxides of nitrogen (NO_x) and volatile organic carbon emissions in the presence of sunlight and heat, which is why we see higher levels in the summer. Summer 2022 was one of the hottest and driest in recorded history, likely causing higher O_3 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.

$PM_{2.5}$, NO_2, NO, and black carbon (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 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_2, $PM_{2.5}$ and BC; in the summer for O_3; and in the winter for SO_2. For more details

Pollutants Measured

Fine Particles

Black Carbon

Black carbon (BC) is one type of $PM_{2.5}$ and is the sooty black material emitted from gas and diesel engines, coal-fired power plants and other sources that burn fossil fuels. It comprises up to 20% of fine particulate matter in New York City. Unlike other fine particles, BC is primarily from local sources. Inhalation of BC is associated

on sample collection methods, see Appendix 1 (PDF).

The New York State Department of Environmental Conservation also has a network of 19 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 real-time air quality.

with health problems, including respiratory and cardiovascular disease, cancer and birth defects. BC also contributes to climate change by altering the patterns of rain and clouds.

Nitrogen Dioxide and Nitric Oxide

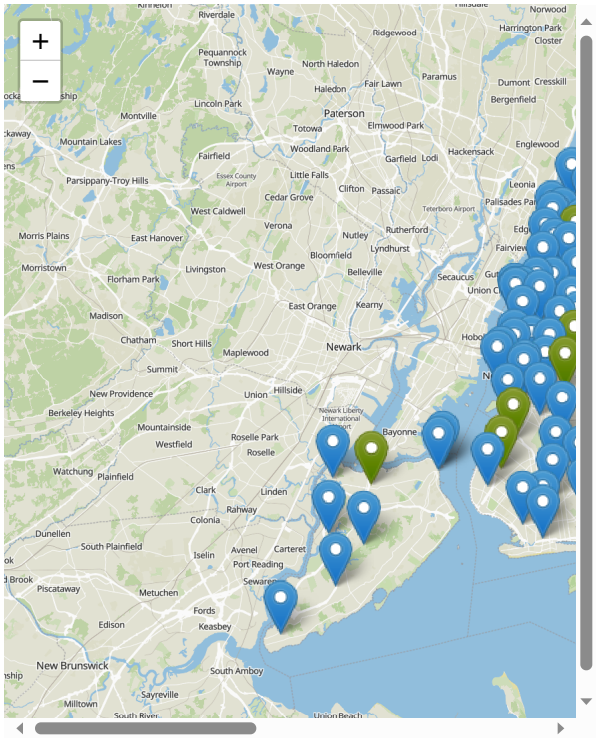
Ozone

Sulfur Dioxide

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 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 high-emission 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 2022, we monitored 78 routine locations and an additional 15 sites in low-income neighborhoods that benefit from additional monitoring to understand potential sources of emissions. We refer to these 15 sites as Environmental Justice Sites, in green on the map, and enhance our monitoring with their data when funding allows. 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.

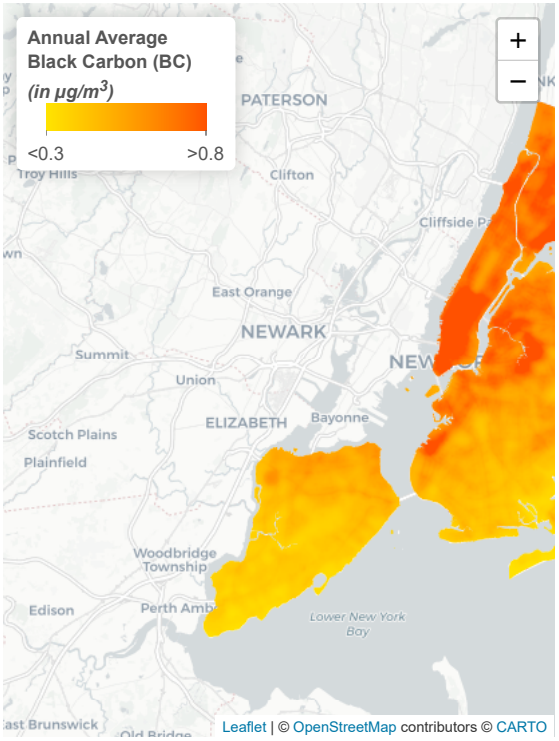
In the maps below, you can select a pollutant to see how air pollution is distributed throughout the city and how it has changed over time. The city's air quality has changed significantly since NYCCAS began monitoring, as can be seen in the maps below. The levels of BC, NO_2, NO, SO_2 and $PM_{2.5}$ 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_2 and $PM_{2.5}$ 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, 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_2, NO and $PM_{2.5}$ are available in Appendix 2 (PDF).

2022: | BC | NO | NO_2 | O_3 | $PM_{2.5}$ | All years



- Citywide, annual average levels of Black Carbon declined by 48% between 2009 and 2022, an average of 0.05 micrograms per cubic meter per year.
- Across the 14-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 2022, seasonal average BC concentrations across NYCCAS monitoring sites ranged from 0.21 to 1.8 micrograms per cubic meter.

Pollutant Trends

Since monitoring began in winter 2008-2009 in New York City, we have seen a decrease in most of the air pollutants we measure. However, the concentrations of NO_2, NO and $PM_{2.5}$ continue to be higher in industrial zones with more diesel truck traffic, neighborhoods with large numbers of restaurants, and areas of higher traffic and building density.

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.

The figure below illustrates how the levels of each air pollutant change by season from winter 2008-2009 to fall 2022. We compare trends among locations with high, medium and low densities of the most common sources of each pollutant.

BC | NO | NO_2 | O_3 | $PM_{2.5}$ | SO_2

Commercial Cooking **Industrial Areas** **Traffic Density**

Black Carbon by Commercial Cooking

micrograms per cubic meter

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_2, BC, and $PM_{2.5}$ across NYC are listed in the table below. SO_2 is now so low in NYC that it has not been possible to build a model for SO_2 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.

BC | NO | NO_2 | O_3 | $PM_{2.5}$

Indicator	Description	Associated sources
Traffic emissions	Area of impervious road surface within 100 m	Emissions of motor vehicles on paved roadways
Commercial cooking	Number of permitted commercial cooking grills and charbroilers within 100 m	Emissions from commercial cooking
Building emissions	$PM_{2.5}$ emissions from heat and hot water oil-burning boilers in buildings within 1000 m	Combustion of heating oil

Indicator	Description	Associated sources
Loading docks	Number of warehouse loading docks within 700 m	Emissions from trucks idling and traveling to and from warehouses

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 $PM_{2.5}$ from Traffic Air Pollution data story.
- NYC OpenData: NYCCAS Air Pollution Rasters.
- New York Community Air Survey: past reports