

The New York City Community Air Survey:

Neighborhood Air Quality 2008-2019

Summary

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 OneNYC, the City's sustainability plan
- Track changes in air quality over time
- Estimate exposures for health research
- Inform the public regarding about local topics, such as: air quality in the time of COVID-19 (<http://a816-dohbesp.nyc.gov/IndicatorPublic/Closerlook/covidair/>), recent

air quality improvements (<http://a816-dohbsp.nyc.gov/IndicatorPublic/Closerlook/breatheeasy/index.html>), car-free zones (<http://a816-dohbsp.nyc.gov/IndicatorPublic/Closerlook/aqts/index.html>), unique studies conducted in New York City (<http://a816-dohbsp.nyc.gov/IndicatorPublic/Closerlook/AQsnapshots/Index.html>) and what NYCCAS monitoring tells us about the city's neighborhoods (<http://a816-dohbsp.nyc.gov/IndicatorPublic/Closerlook/aq2/index.html>).

This report:

- Provides a summary of key findings (#Findings), the air monitoring program (#Methods), monitoring site selection (#Sites), and descriptions of the pollutants measured (#Pollutant_Description)
- Describes the trends in air pollutant levels (#Pollutant_Sources) from more than a **decade of data** between winter 2008-2009 through fall 2019 for fine particulate matter (PM_{2.5}), nitrogen dioxide (NO₂), nitric oxide (NO), black carbon (BC), wintertime sulfur dioxide (SO₂) and summertime ozone (O₃)
- Presents maps of neighborhood air pollution levels (#Pollutant_Maps) by year
- Identifies the local sources (#Pollutant_Predictors) that contribute to high levels of these pollutants in New York City neighborhoods

Key Findings

Citywide, annual average levels of three key pollutants have gone down between the first year of monitoring, 2009, and the most recent year of data, 2019

| | |
|-------------------------------------|------|
| Fine particles (PM _{2.5}) | -38% |
| Nitrogen Dioxide (NO ₂) | -33% |
| Nitric Oxide (NO) | -52% |

Air quality improved significantly after the city required building owners to convert to cleaner heating oils by 2015

Since the first winter of monitoring, average levels of sulfur dioxide (SO₂) have declined by **97%**. In 2019, only 10 of our 60 core sites detected any SO₂, and the levels at those sites were similar to SO₂ levels measured on Whiteface Mountain in the Adirondack Mountains, demonstrating the success of the clean heating oil requirements.

Air quality changes with location

PM_{2.5}, NO₂, NO, and BC are highest in:

- Areas with higher density of commercial cooking grills and charbroilers
- Areas of higher traffic density
- Areas with higher building density
- Industrial areas

Ozone levels are highest in:

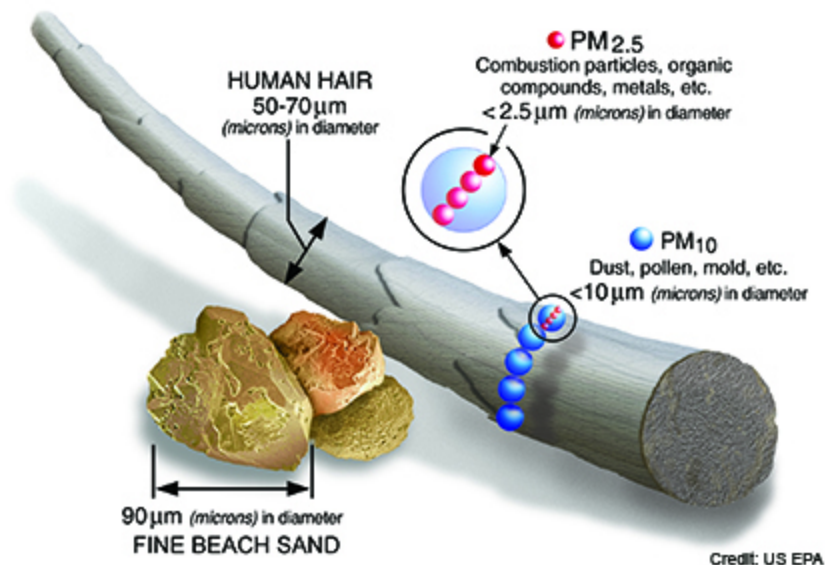
- The outer boroughs
- Areas that are downwind of high NO_x (oxides of nitrogen) emissions
- Areas with fewer combustion emissions

Pollutants Measured by NYCCAS: Health Effects and Sources

Fine Particles

Fine particles (PM_{2.5}) are tiny airborne solid and liquid particles less than 2.5 microns in diameter. PM_{2.5} is the most harmful urban air pollutant. It is small enough to penetrate deep into the lungs and enter the bloodstream, which can worsen lung and heart disease and lead to hospital admissions and premature deaths. PM_{2.5} causes cancer.

PM_{2.5} can either be directly emitted or formed in the atmosphere from other pollutants. Fuel combustion in vehicles, boilers in buildings, power plants, construction equipment, marine vessels and commercial cooking are all common sources of PM_{2.5}. Up to 40% of the PM_{2.5} in New York City's air comes from sources in areas upwind from the city, such as coal-burning power plants in the Midwest.



Black Carbon

Nitrogen Dioxide and Nitric Oxide

Ozone

Sulfur Dioxide

NYCCAS 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, NO₂, PM_{2.5} and BC; in the summer for O₃; and in the winter for SO₂. For more details on sample collection methods, see Appendix 1 (PDF) ([/nyccas2021/web/sites/default/files/NYCCAS-appendix/Appendix1.pdf](https://nyccas2021/web/sites/default/files/NYCCAS-appendix/Appendix1.pdf)).

The New York State Department of Environmental Conservation also has a network of nineteen 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

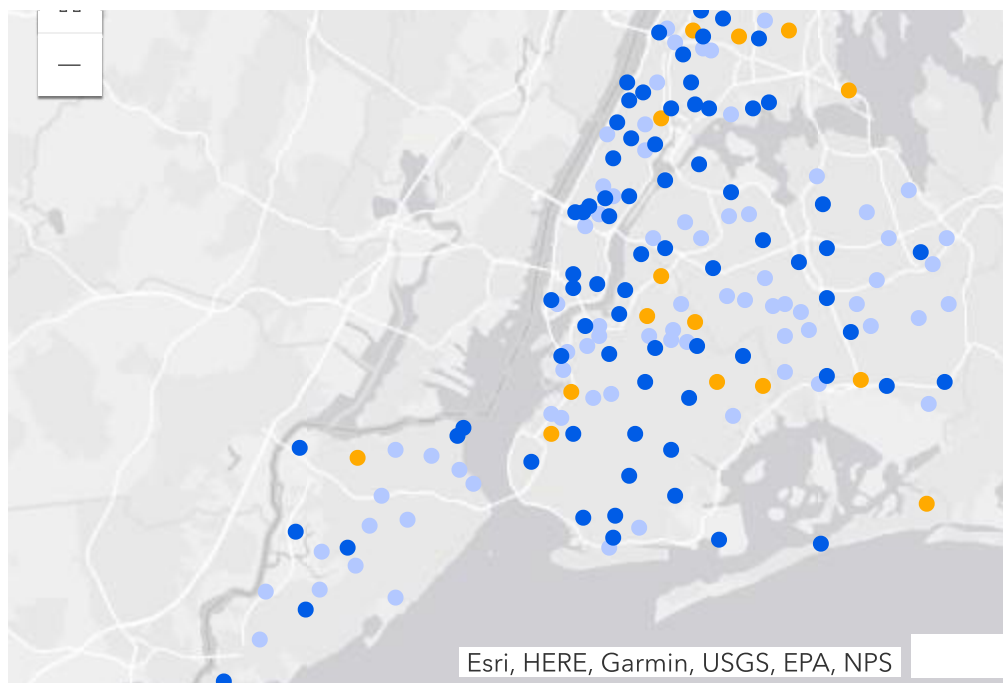
measure pollution where people spend time, and where traffic-related pollution levels are usually higher.



NYCCAS 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 at random to ensure representation in all types of neighborhoods, including residential, commercial and industrial areas. The remaining sites were selected because they are near potentially high-emission locations that were not captured in the random assignment. These include Times Square, the Port Authority Bus Terminal and the entrance to the Holland Tunnel. The locations vary in tree canopy and in the density of traffic and buildings. The number of sites has changed over the years as we have learned about air quality in our city. In 2019, we monitored 78 routine locations and an additional 15 sites in low-income neighborhoods that would benefit from additional monitoring to understand potential sources of emissions. We refer to these as Environmental Justice Sites (<http://a816-doh.besp.nyc.gov/IndicatorPublic/Closerlook/AQsnapshots/Index.html#section5>) on the map.





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● Routine Site ● Environmental Justice Site ● Retired Site

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 land-use regression (LUR) model. We then used the associations from these models to estimate the seasonal 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) (</nyccas2021/web/sites/default/files/NYCCAS-appendix/Appendix1.pdf>). For more details on the analysis methods, see NYCCAS Scientific Publications (<https://www1.nyc.gov/site/doh/data/data-publications/air-quality-nyc-community-air-survey.page#nyccas-pubs>).

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. Winter and summer average maps for BC, NO₂, NO and PM_{2.5} are available in Appendix 2 (PDF) (</nyccas2021/web/sites/default/files/NYCCAS-appendix/Appendix2.pdf>).



Pollutant Sources

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 concentration of each of these pollutants continues to be higher in industrial areas, as well as 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, SO₂ mainly comes from big buildings burning No. 6 (the dirtiest) fuel oil for heat and hot water. We only monitor SO₂ in the winter when heating

demand is highest. SO₂ levels have gone down dramatically since Local Law 43 of 2010 (<https://www1.nyc.gov/assets/dep/downloads/pdf/air/local-law-43-biodiesel-fuel-requirement.pdf>) prohibited the burning of heavy fuel oil (No. 6) in New York City buildings.

The figure below illustrates how the levels of each air pollutant change by season from winter 2008-2009 to fall 2019. We break out locations with high, medium and low densities of the most common sources of each. Since winter 2017-18 there have been too few sites with SO₂ values above the detection limit for us to include it in this chart.



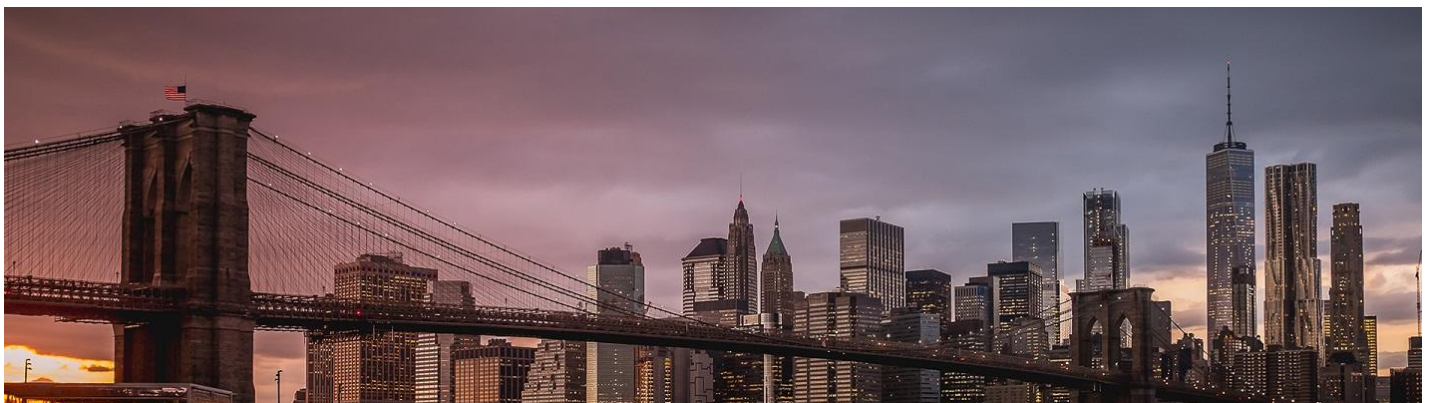
Pollutant Predictors

NYCCAS data were analyzed using a land-use regression (LUR) model. LUR models estimate associations among pollution levels, average traffic, building emissions, land use and other neighborhood factors around the monitoring sites. The pollution sources that contribute most to differences in concentrations of NO, NO₂, BC, and PM_{2.5} across NYC are listed in the table below. SO₂ is now so low in NYC that it is not possible to build a LUR model for the most recent years of data.

Commercial charbroiling and grilling operations (i.e., restaurants, hotels, meeting halls) have become a more important source of PM_{2.5} emissions over the past several years. At the same time, building emissions have been reduced largely due to state and local regulations mandating cleaner burning fuels for building heat and hot water. As a result, the number of commercial cooking charbroilers and grills is more important in the 2019 model in explaining PM_{2.5} differences between neighborhoods than building emissions. For more information on these changes, please see Tracking changes in New York City's sources of air pollution (<http://a816-dohbesp.nyc.gov/IndicatorPublic/Closerlook/aq-cooking/index.html>).



Conclusion



This report underscores the importance of emissions reduction efforts over the past decade and highlights the continued need to reduce emissions citywide. The City's sustainability plan, OneNYC (<http://www1.nyc.gov/html/onenyc/index.html>), and its roadmap to reduce greenhouse gas emissions, 80x50 (<http://www1.nyc.gov/site/sustainability/codes/80x50.page>), have already and will continue to improve air quality and provide important public health benefits to all New Yorkers. These strategies and measures include:

- Transitioning to more efficient, less polluting light-duty and heavy-duty vehicles
- Reducing motor vehicle use by shifting to more sustainable modes of transportation
- Creating more efficient freight networks and expanding truck retrofit and replacement programs
- Reducing fossil fuel combustion in buildings

Additionally, reducing emissions from other widely distributed sources of pollution, such as BC and PM_{2.5} from commercial charbroiling, will contribute to improved air quality in the future.

More Information:

- Appendix 1 (PDF) (</nyccas2021/web/sites/default/files/NYCCAS-appendix/Appendix1.pdf>) : Sampling Methodology and Data Sources for Emissions Indicators.
- Appendix 2 (PDF) (</nyccas2021/web/sites/default/files/NYCCAS-appendix/Appendix2.pdf>) : Seasonal Average Pollutant Maps.
- Appendix 3 (PDF) (</nyccas2021/web/sites/default/files/NYCCAS-appendix/Appendix3.pdf>) : Community District Average Pollution Levels
- NYCCAS Air Quality Data Hub (<http://a816-dohbsp.nyc.gov/IndicatorPublic/AQHub/index.html>)
- Environment & Health Data Portal (<http://a816-dohbsp.nyc.gov/IndicatorPublic/publictracking.aspx>) : Neighborhood-level data and neighborhood air quality reports
- The Public Health Impacts of PM_{2.5} from Traffic Air Pollution data story. (<http://a816-dohbsp.nyc.gov/IndicatorPublic/Traffic/index.html>)
- NYCCAS Air Pollution Rasters on NYC OpenData (<https://data.cityofnewyork.us/Environment/NYCCAS-Air-Pollution-Rasters/q68s-8qyv>).
- New York Community Air Survey: past reports (<http://www.nyc.gov/health/nyccas>)

The logo consists of the text "#OneNYC" in white, set against a solid blue rectangular background.

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