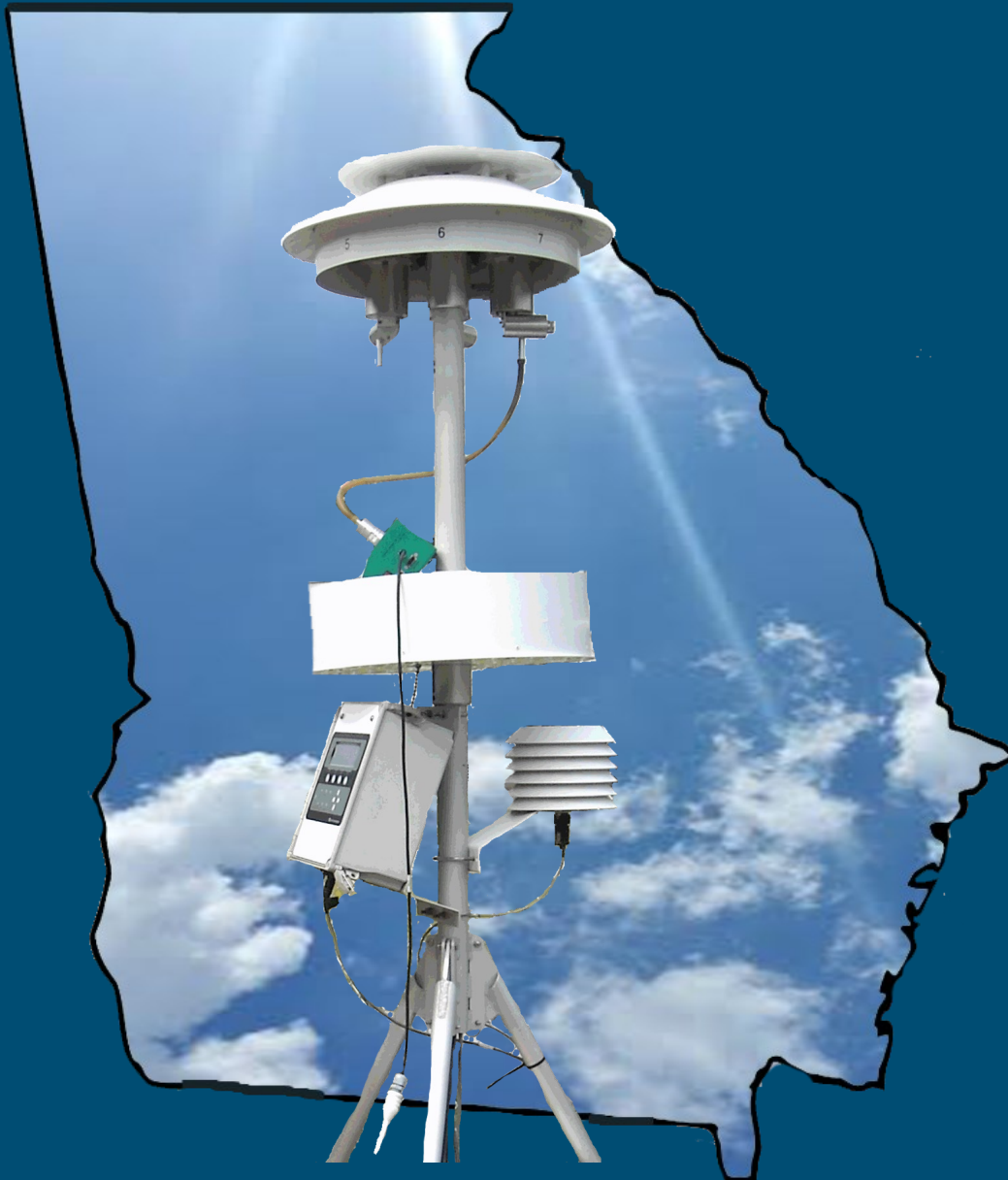# AIR PROTECTION BRANCH

2020 Air Quality Report

GEORGIA
DEPARTMENT OF NATURAL RESOURCES

ENVIRONMENTAL PROTECTION DIVISION

Informational Publication

This document is published annually by the Ambient Monitoring Program, in the Air Protection Branch of the Georgia Department of Natural Resources, Environmental Protection Division.

DISCLAIMER: Any reference to specific brand names is not an endorsement of that brand by the Georgia Environmental Protection Division.

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Introduction

EPD Mission

The Environmental Protection Division (EPD) protects and restores Georgia's environment. We take the lead in ensuring clean air, water, and land. With our partners, we pursue a sustainable environment that provides a foundation for a vibrant economy and healthy communities.
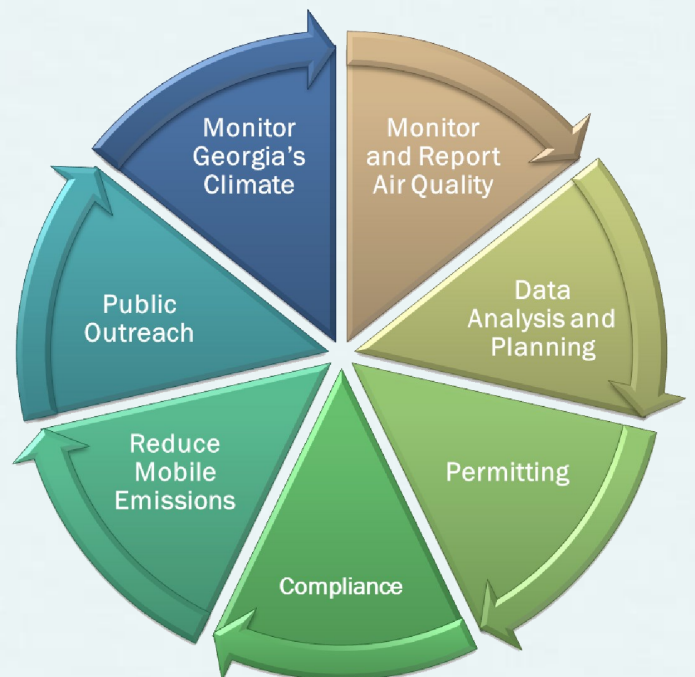
Who We Are

- This report is prepared by the Ambient Monitoring Program (AMP), a program of the Air Protection Branch of the Georgia Environmental Protection Division (EPD), the State's lead environmental agency and a Division of the Georgia Department of Natural Resources.

- The Air Protection Branch ensures clean air in Georgia in support of Georgia EPD's mission.

- The environmental professionals (scientists, meteorologists, and engineers) who make this report possible make sure Georgia produces air quality data that is accurate, complete, and readily available for public use.

- The Air Protection Branch has six programs:
    1. Ambient Monitoring
    2. Mobile and Area Sources
    3. Planning and Support
    4. Radiation Protection
    5. Stationary Source Compliance
    6. Stationary Source Permitting

What We Do

- Monitor air quality in Georgia

- Forecast air quality for public use

- Develop plans to maintain or attain the National Ambient Air Quality Standards (NAAQS)

- Issue permits to regulated stationary sources (industrial facilities and power plants)

- Enforce all state and federal requirements through compliance activities (inspections)

- Oversee federally required emission testing on cars

Air Quality in Georgia: 2020

The Ambient Monitoring Program of the Georgia Environmental Protection Division's Air Protection Branch has been monitoring air quality in the State of Georgia for more than forty-five years. During that time, the list of monitored compounds has grown to more than 200 pollutants at 38 sites in 28 counties across the state. This monitoring is performed to protect public health and environmental quality. The resulting data is used for a broad range of regulatory and research purposes, as well as to inform the public.

This report includes monitoring data from 2020 and shows that the air quality in Georgia has steadily improved over the last few decades.

Key Items of Interest

- During the COVID-19 pandemic (discussed on page 18), no ambient air monitoring was suspended. The Ambient Monitoring Program was able to make necessary adjustments and continue operations as 'normal'.

- For the first time since the National Ambient Air Quality Standards (NAAQS) were implemented, Georgia is meeting all of the air quality standards.

- The Ambient Monitoring Program is involved with several special studies in addition to routine monitoring. Refer to pages 15 and 17 for more details.

A lot has changed in 45 years of air quality monitoring.

How are we doing as a state?

Between 1990 and 2020, total emissions of the six principal air pollutants dropped by 75 percent, while the gross domestic product increased by 340 percent.
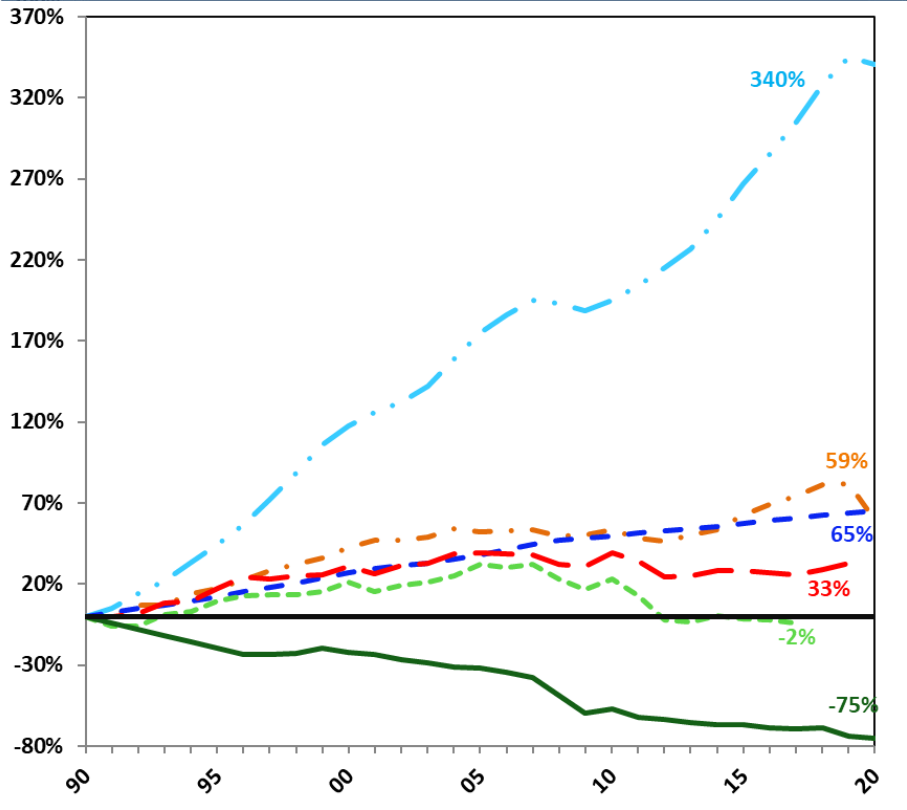
Air Monitoring FAQs

Where are the monitors located?

Over 100 air samplers (called monitors) are located throughout Georgia that measure for nearly 200 air pollutants. These pollutants can be gaseous such as ground-level ozone, or can be very fine particles such as particulate matter 2.5 ($PM_{2.5}$), also known as particle pollution.

How are air samples collected?

There are two types of collection methods depending on the pollutant and the monitor:

- **Continuous** - The air pollutant is measured and analyzed onsite continuously and the data is automatically recorded at a centralized location into a database.
- **Non-Continuous** – A canister or filter is used to collect the air pollutant over a period of time (8-hr, 24-hr). A field operator collects the canister or filters and takes them to an approved laboratory for analysis.

How do we know the air quality data is accurate?

Both the continuous and non-continuous data are screened for errors by validation specialists. When the data is certified as valid, it can be reported to the public and used to compare to the National Ambient Air Quality Standards, and to previous years' data for trend information. The validated data is also used by scientists and policy makers.

- **Validated data** is used to prepare publications such as the Annual Report and EPD's Annual Network Plan.
- **Non-Validated data** includes hourly data from continuous monitors published as the Air Quality Index (AQI) on the Georgia Air Monitoring website (https://airgeorgia.org/) and AirNow, a national air quality database, to provide real-time information.

What is the Air Quality Index (AQI)?

The Air Quality Index, or AQI, is a color-coded indicator of what the air quality is like taking into consideration measurements of multiple pollutants including ozone, particulate matter, sulfur dioxide, nitrogen dioxide, and carbon monoxide.

Good	Air quality is considered satisfactory, and air pollution poses little or no risk
Moderate	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	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	Health warnings of emergency conditions. The entire population is more likely to be affected.
Hazardous	Health alert: everyone may experience more serious health effects

What is the air quality like where I am?

Real time, hourly, air quality data for your area is available on the Georgia Air Monitoring Website at https://airgeorgia.org/. Georgia's air quality data is also uploaded to a national air quality information database called AirNow (https://airnow.gov) and available to the public in real time.

Why don't we have monitoring everywhere?

The number of monitoring sites and their location can vary from year to year. The cost associated with establishing and running a monitoring station is significant. It involves maintaining equipment and collecting samples to produce quality data for public use. EPD does not own land at any of its ambient air monitoring stations, we are always either a guest or a leaseholder. Each monitoring station must meet federal siting criteria set by EPA and be approved by the landowner. Before deciding to establish a new monitoring station, EPD has to consider regulatory needs, funding limitations, and finding an appropriate location where a long-term arrangement is possible. If EPD determines a change is needed, EPA has to review and approve the changes before the changes can happen.

Air Quality FAQs

What are National Ambient Air Quality Standards (NAAQS)?

Under the Clean Air Act, EPA is required to set National Ambient Air Quality Standards (40 CFR part 50) for air pollutants that may be harmful to public health and the environment. There are two types of National Ambient Air Quality Standards. *Primary standards* protect public health, including protecting populations considered "sensitive," such as children, the elderly, and asthmatics. *Secondary standards* protect public welfare, including protection against damage to animals, crops, vegetation, and buildings, and decreased visibility in national parks and protected areas.

The EPA has set National Ambient Air Quality Standards for six pollutants, called "criteria" air pollutants. These standards are periodically reviewed, as required by the Clean Air Act, and revised, as appropriate.

What is 'attainment?'

With the criteria pollutants, a geographic area that meets or does better than the national ambient air quality standard (NAAQS) is called an *attainment area*. An area that does not meet this standard is called a *nonattainment area*. (www.epa.gov).

Where do we get emission inventory?

The National Emissions Inventory (NEI) is a detailed estimate of air emissions that include criteria pollutants and hazardous air pollutants. It is released every three years and it is based on data provided by the State, Local and Tribal Agencies.

Examples of Air Monitors in Georgia

Communication and Partnerships

Georgia EPD's Ambient Air Monitoring Website

Air Quality Forecast

Site Information

Links to Annual Reports

Trends in Georgia's Air

Pollutant Information

And So Much More...

Visit us at https:// airgeorgia.org/

Carbon Monoxide (CO)

Oxides of Nitrogen (NO₂)

Sulfur Dioxide (SO₂)

Ozone (O₃)

Lead (Pb)

Particulate Matter (PM)

Follow the State of Georgia Climate Office on Social Media

https://www.facebook.com/georgiaclimate/

https://twitter.com/gaclimateoffice
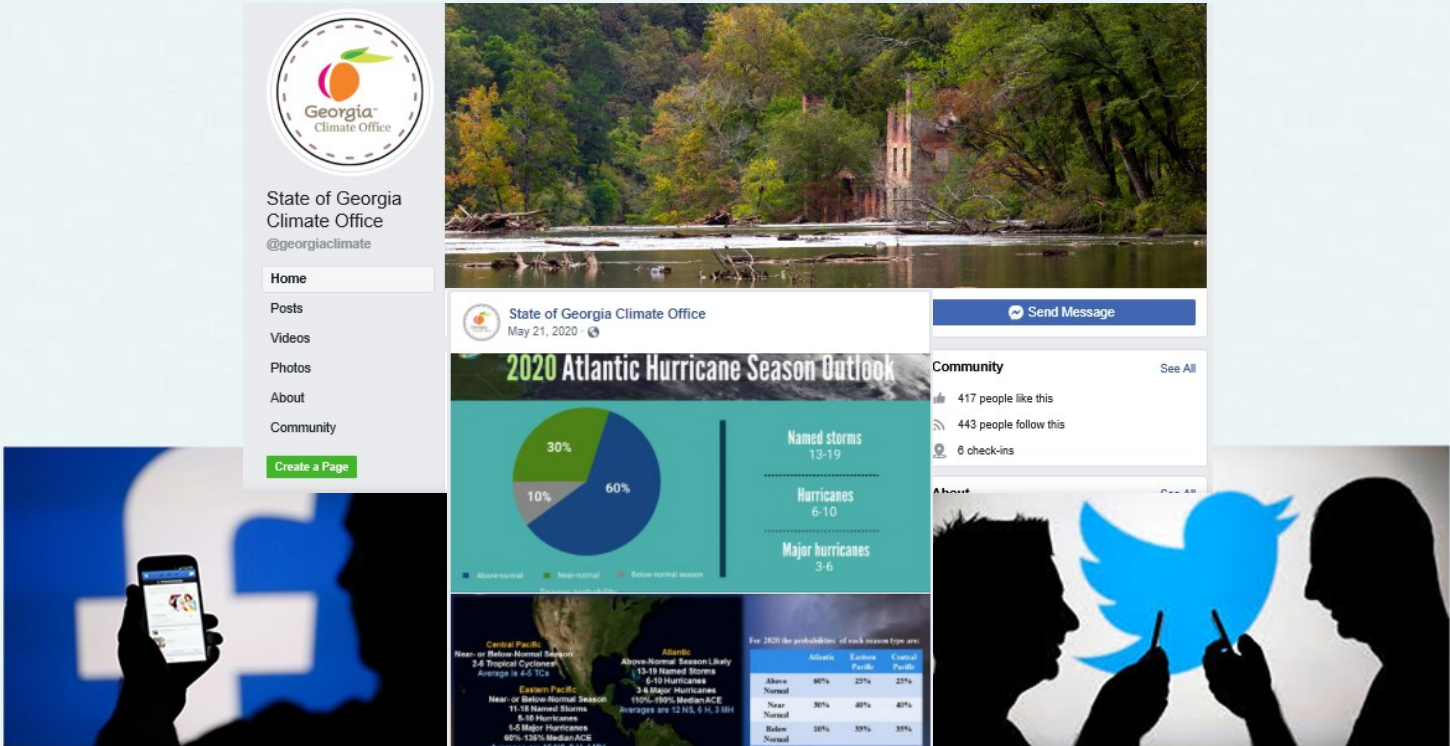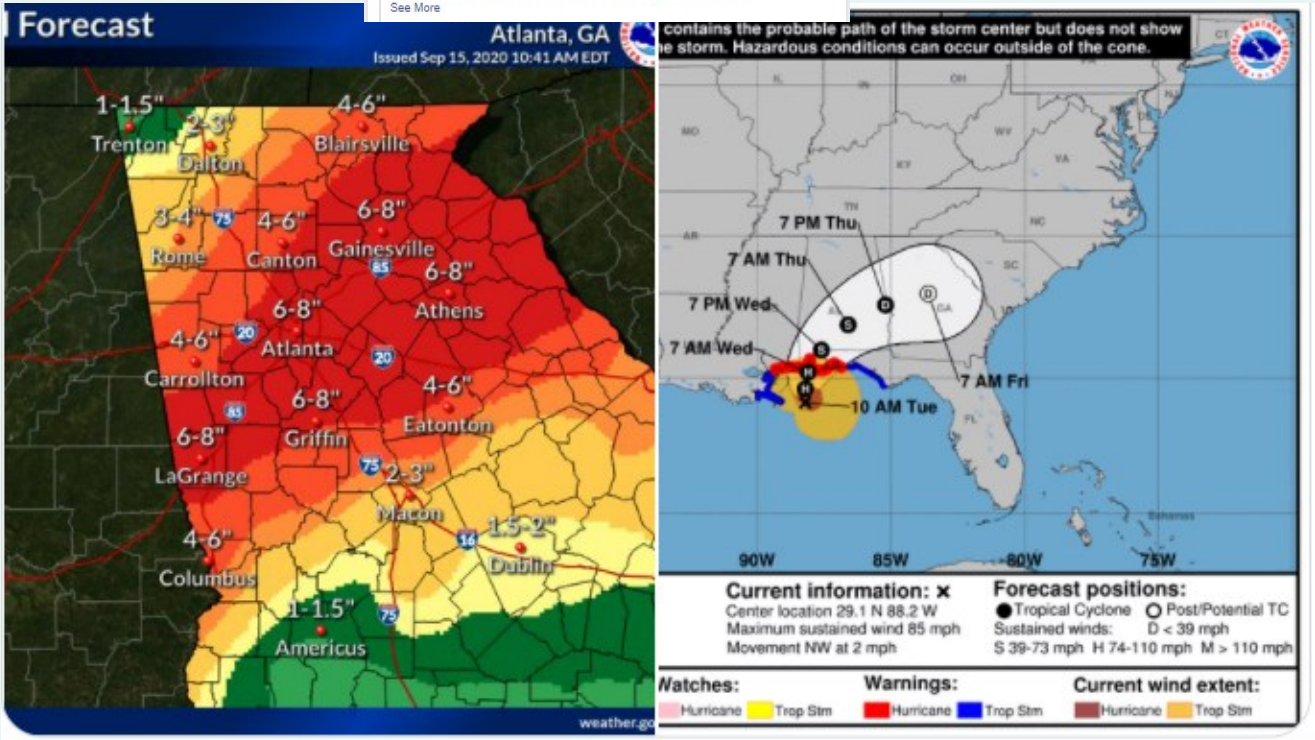
Air Quality Awareness Week (AQAW)

In 2020, the Air Protection Branch hosted its third annual (first virtual) Air Quality Awareness Week. Air Quality Awareness Week is a collaboration between EPA, NOAA National Weather Service, Centers for Disease Control and Prevention (CDC), U.S. Forest Service, and U.S. Department of State. They have dedicated the first full week of May for air quality awareness: to promote understanding of air pollution effects on health and to encourage people to check the Air Quality Index (AQI) daily. GA EPD is doing its part to amplify that message in Georgia. Daily informational emails were sent every morning , highlighting a different air quality topic and included a daily action item to help reduce air pollution. Great presentation topics were discussed to show what great efforts are ongoing to improve air quality. The presenters and presentations are highlighted here.

Every day, the Air Protection Branch gave a daily task (to reduce air pollution):

Bicycling, walking, turning off lights, and/or limiting energy usage.
Dine locally, purchase seasonal food from a nearby farm, and/or start a garden.
Setting a programmable thermostat higher in the summer.
Reduce water usage.

Georgia Inspection and Maintenance Through the Ages

EPA@50: A Reflection on Effective Partnerships in Improving Air Quality

History of DOA's Efforts to Identify and Then Reduce Air Pollutants/Precursors

Delta Air Lines – National Operations Overview and Compliance

What is Georgia Commute Options?

Transportation Demand Management and Greenhouse Gas Reduction Efforts at ARC

Atlanta Roadside Emissions Exposure Study (AREES) and an Update on the Connected Vehicle Study

Working Together

The Ambient Monitoring Program gives tours and explains ambient air monitoring equipment to employees of other EPD branches, US EPA, Centers for Disease Control, Agency for Toxic Substances Disease Registry, and Georgia Department of Public Health. This helps give a better understanding of how the ambient air quality data is collected for research organizations and public citizens to use.
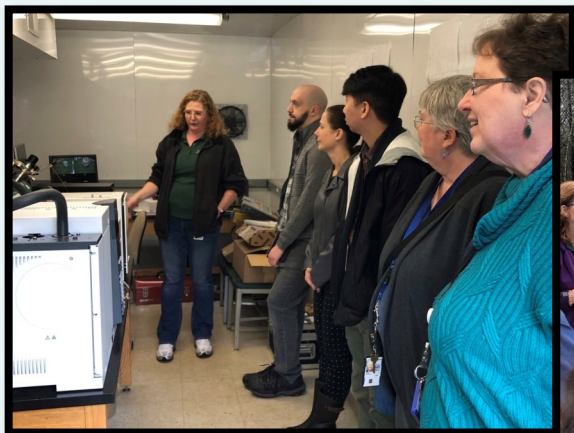
Reaching out into the Community

Educating school children and incorporating air quality information into the classroom-learning environment is an outreach strategy for the GA EPD Ambient Monitoring Program (AMP). AMP staff visit Georgia classrooms to discuss air quality, forecasting, and monitoring. Each program presented by the AMP is designed to supplement grade-specific curricula. Learning opportunities include meteorological lessons and forecasting techniques, among other relevant topics.

In many situations, these lessons involve hands-on activities and mini-field trips to the monitoring sites. High School students simulate forecasting conditions and use scientific methods to create their own forecasts. AMP staff also participate in Career Days at both elementary and high schools to promote environmental and meteorological careers.
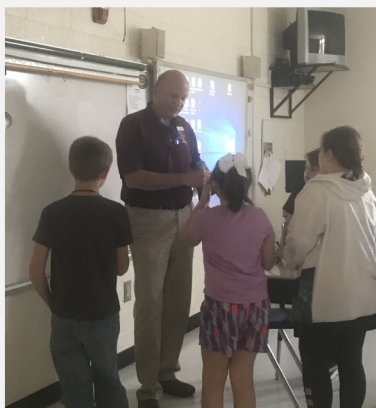
GA EPD air quality forecasters presenting information at air quality conferences.

GA EPD air quality forecasters presenting to local schools and judging science fairs.

THE ROTARY CLUB OF BRUNSWICK

State Climatologist, Bill Murphey, gives a State Climate Office Update to The Rotary Club of Brunswick.

View from the Great Smoky Mountains

Courtesy of Jim Renfro from the Great Smoky Mountains National Park

Hurricane Sally (Cat 2) 9/10~9/18

Note: Satellite data was not available before the 1960s. Data from NOAA https://coast.noaa.gov/hurricanes/#map=4/32/-80
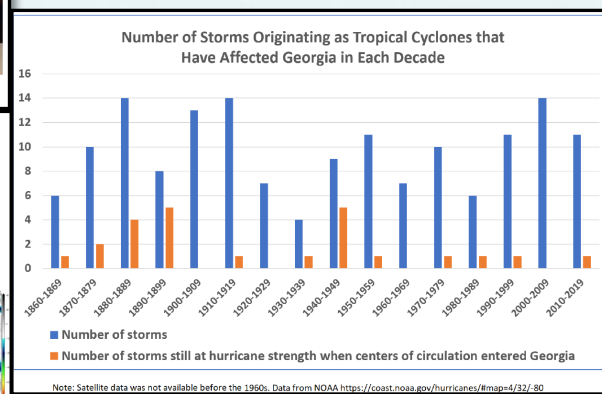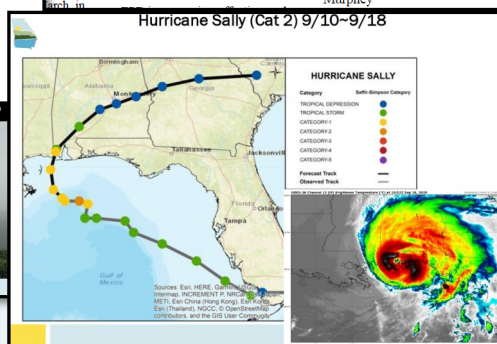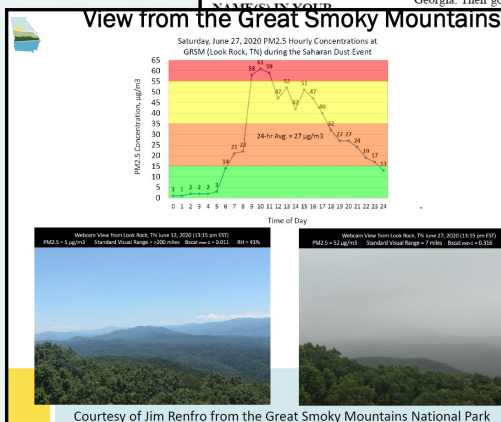
Special Projects

The Ambient Monitoring Program is involved in several special air quality monitoring projects. Details are discussed below.

CAIRSENSE– (2014-2016) EPA testing of various sensors, including mesh-net communication. Sensors included: Air Egg (NO_2, CO, VOCs, PM), Cairpol Cairclip (NO_2/O_3), Dylos (PM particle counter), AirBeam ($PM_{2.5}$), and Aeroqual (O_3).
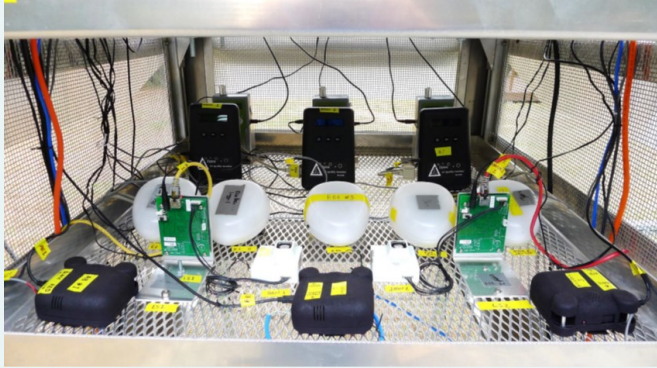
EPD Sensor Testing Project– (2016-2020) to gain understanding of what is involved with the operation of various types of sensors available to the general public. Comparison with regulatory monitors, maintenance, repairs, communication, data formatting and manipulation, etc., and how to explain issues and discuss proper considerations with the public. Sensors include: Aeroqual (O_3), Aeroqual (SO_2), Cairclip (NO_2/O_3), Dylos (PM), and a Met One Neighborhood Monitor (PM).

Gwinnett Technical College– (2018-2020, Kathryn Zimmerman) Gainesville, South DeKalb, NR-285, Gwinnett Technical College – passive PUF samplers, analyzed by students on a gas chromatograph (GC) at school.

GA State University– (2019-2020, Dr. Christina Hemphill Fuller) – NR-GA Tech, NR-285 – Particle Barrier Study to see to what degree barrier walls or shrubbery mitigates particle impacts from nearby roadways. Looking at ultrafine particles using TSI Nanoscan (PM) and AethLabs Microaeth (BC) for portable, continuous data, compared to the fixed monitors at nearby sites for mass comparison.

EPA/Office of Research and Development Long Term Performance Project– (2019-2020) to investigate the durability and stability of operating various sensors over an extended period of more than a year. Attention to seasonal response variations, response drift over time, sensitivity degradation, maintenance issues, and other factors associated with extended operation at various (6) locations around the country (DE, AZ, CO, OK,WI, GA). Instruments are: PurpleAir (PM), Applied Particle Tech [PM, Temperature (T), relative humidity (RH)], Sensit RAMP (CO,O_3, NO_2, SO_2, $PM_{2.5}$) Clarity (CO_2, $PM_{2.5}$, T, RH), Aeroqual (O_3, NO_2, $PM_{2.5}$, T, RH), Aerodyne QuantAQ (O_3, NO_2, NO, CO, CO_2, PM, T, RH, Wind Speed, Wind Direction, light, noise).

University of Central Florida– (2019, Haofei Yu) South DeKalb – sensor evaluation study in comparison with regulatory monitors. Sensors are Salibri Cooper SCI-608 O_3, CO, SO_2, NO_2, and PM; and a Sapiens NAS-200 PM, O_3, NO_2, CO, and SO_2.

Special Projects

EPA/Region 4 Rail and Port Sensor (RAPs) Project– (2018-2020) to investigate the usefulness of portable, inexpensive, sensors to evaluate the impacts of Ports on immediately surrounding areas. Sensor "Pods" with Solar panels and batteries were deployed at most sites. Locations selected were in the area of the Inman Railyard in metro-Atlanta. Sensors are predominantly Purple Air PM, and also MicroAeth Black Carbon, and a portable meteorological station.

AMOD – Emory/NASA/CSU– (2020, Yang Liu, Jeremy Sarnat) Sun tracking, Aerosol Mass Optical Depth sensor which uses Plantronics PM sensors (like PurpleAir) and also collects a filter based sample; developed by Colorado State University. Deployment at South DeKalb, pending development of mounting platform.
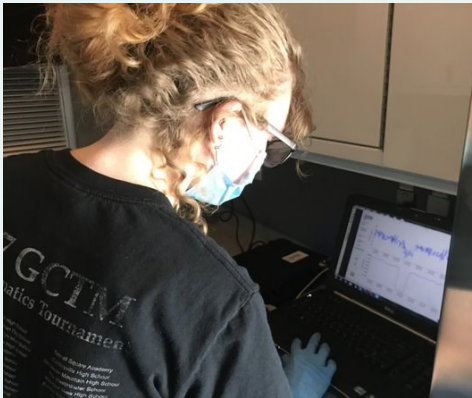
Georgia Institute of Technology (GA Tech)– (2016-2020, Dr. Jennifer Kaiser, Dr. Ted Russell) NR-GA Tech– A Markes Agilent GC along with various PM sensors. Pandora– in collaboration with NASA, a study of the impacts of the pandemic shutdown of air traffic at ATL and BWI airports. Deployment of two Pandora NO_2 optical depth trackers, a standard NOx monitor, formaldehyde (HCHO) monitoring, a full sky camera, and a meteorological suite.

Savannah/Harambe House– (2019-2020, Dr. Mildred McClain, Dr. Sacoby Wilson) – Began with EPA Ports Study in 2016-2018. Became a community-based citizen science and environmental justice project for residents of Hudson Hills and surrounding neighborhoods to learn how they could use sensors to determine the impacts on their residences of the nearby Port of Savannah and its proposed expansion. An overlapping effort is the GA Tech SMART sea level sensor project to help detect and alert citizens about tidal surges and inland flooding (Dr. Russell Clark, Dr. Kim Cobb, Nick Defley – Savannah Office of Sustainability, Randall Mathews – Chatham County Emergency Management). Six Purple Air PM sensors have been donated by Dr. Fuller (GA State University) and will be collocated at the EPD Savannah-L&A site for "calibration", then deployed into neighborhood locations.

Ethylene Oxide Monitoring Project

Background:

- The National Air Toxics Assessment (NATA), which is updated approximately every three years, provides estimates of the risk of cancer and other serious health effects from inhaling air contaminated with toxic pollutants from large and small industrial sources, from on- and off-road mobile sources, and from natural sources such as fires. The latest available NATA report uses the 2014 National Emission Inventory (NEI), and in August of 2018, the NATA presented the updated estimated cancer risks at the census tract level. With this updated information, the NATA report identifies 18 areas of the U.S. that potentially have elevated long-term (chronic) cancer risks due to ethylene oxide emissions from stationary industrial sources. The Atlanta-Sandy Springs-Roswell Metropolitan Statistical Area (Atlanta MSA) was identified as one of these areas. EPD's more refined modeling analysis determined that the risk was not as high as suggested in the NATA. In response to citizen concerns, EPD began collecting ethylene oxide data in 2019. The map below shows the areas where EPD has ethylene oxide monitors.

Sources and uses of ethylene oxide:

- Manufacture of ethylene glycol (antifreeze), solvents, detergents, adhesives and other products, fumigant and a sterilant for surgical equipment and plastic devices

Objectives of the study include:

- Characterizing ethylene oxide concentrations in the ambient air near identified facilities in Georgia

- Providing background concentrations for comparison at two previously established GA AAMP network sites, South DeKalb and the General Coffee monitoring station

- Providing quality data for risk characterization by other agencies

For more information and data, check out the EPD's website:

https://epd.georgia.gov/ethylene-oxide-information
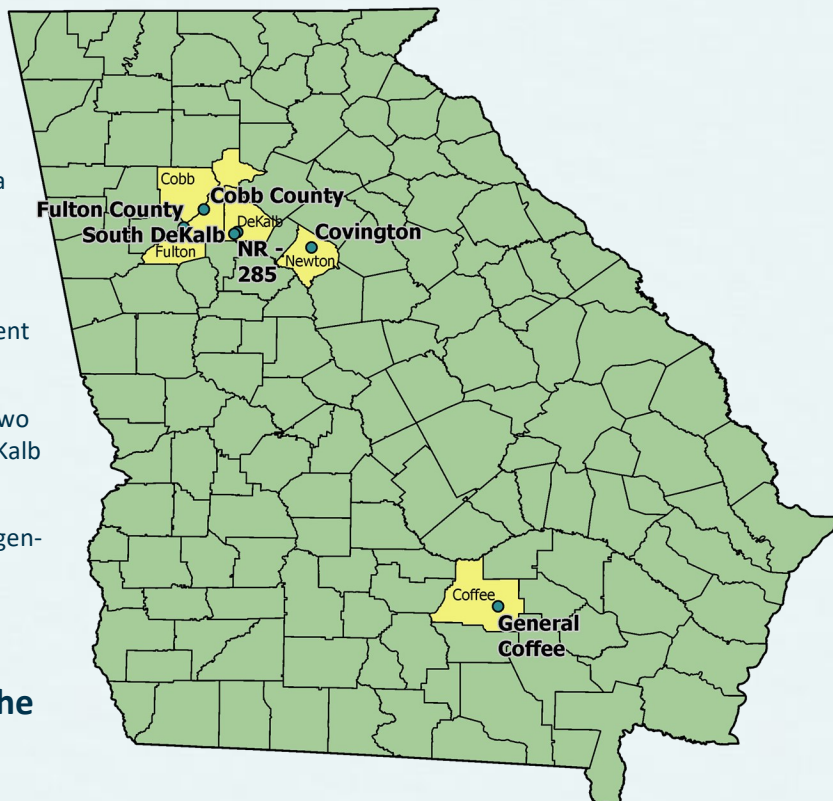
Figure 1. Areas of ethylene oxide monitors in Georgia

Figure 2. Monitors used to collect ethylene oxide monitors in Georgia (from left to right: ATEC 2200, Xonteck 911, Entech CS1200E passive sampler, Xonteck 910)

COVID-19 Lockdown Effects on Air Quality: a Comparison of 2019 and 2020 Data

In March 2020, the COVID-19 pandemic resulted in many changes for the state of Georgia. Due to the pandemic, everyday life for people all over the world has changed. Businesses were shut down and only essential workers were allowed to work. This resulted in less people being on the road and inside businesses.

The state of Georgia issued a public health emergency declaration to try to combat the COVID-19 pandemic. Because of that, people were not using transportation such as cars, buses, or airplanes as much, especially during Spring 2020. According to the Atlanta Journal Constitution (AJC), the Atlanta airport handled 42.9 million passengers in 2020 compared to 110.5 million passengers in 2019, according to the airport's year-end traffic report. The Atlanta traffic congestion level also dropped in 2020. This resulted in a decrease in the ozone, $PM_{2.5}$, NO_2 and AQI values, which were the main pollutants that were being focused on for comparison to previous years' air quality. Overall, Georgia saw a decrease in the numbers during the COVID-19 pandemic. The graphs below show the monthly averages of hourly maximum values for all the Atlanta metropolitan statistical area (MSA) monitors and for 2019 and 2020.

Ozone levels decreased because many jobs such as factories had decreased production or were closed, and travel by cars, airplanes and other means of transportation was reduced. In addition, the meteorological conditions for 2020 were cooler and wetter, which was not favorable to the formation of ozone.
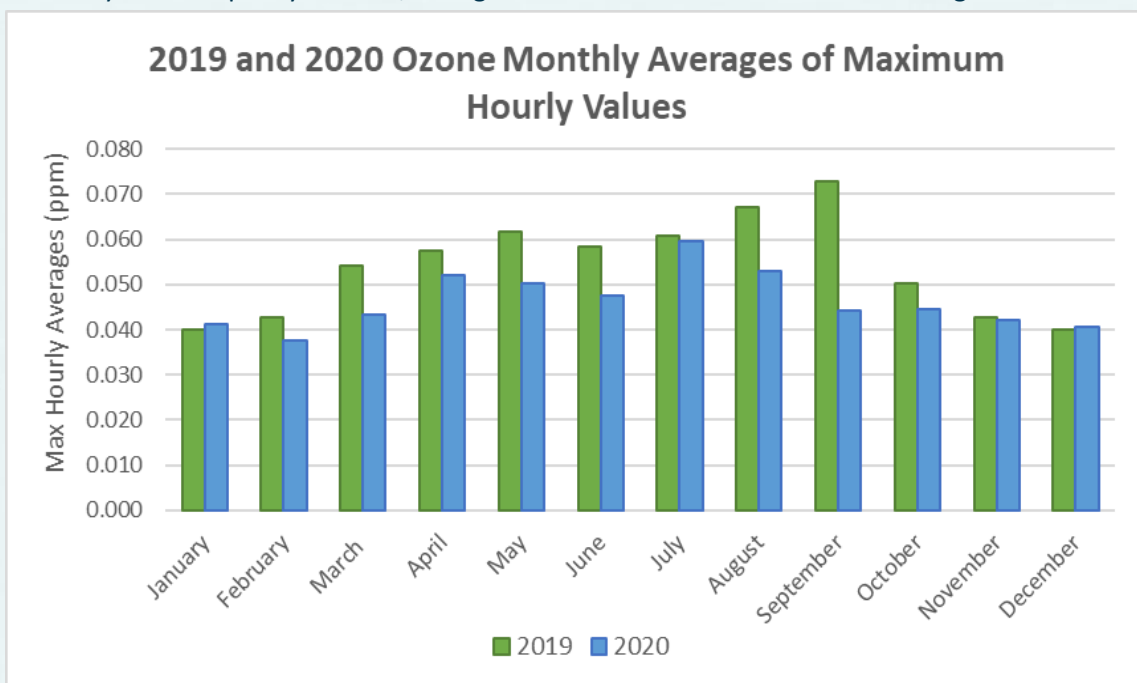
Figure 2. Ozone monthly averages, 2019 and 2020

$PM_{2.5}$ decreased, at least in part, because chemicals that were produced from power plants, diesel trucks and other industrial plants were reduced due to reduced workloads. Meteorological conditions were cooler and wetter, which could have contributed to lower $PM_{2.5}$ data for 2020. For $PM_{2.5}$, in the Atlanta MSA, the month of February had the greatest percent difference of 51.9%.
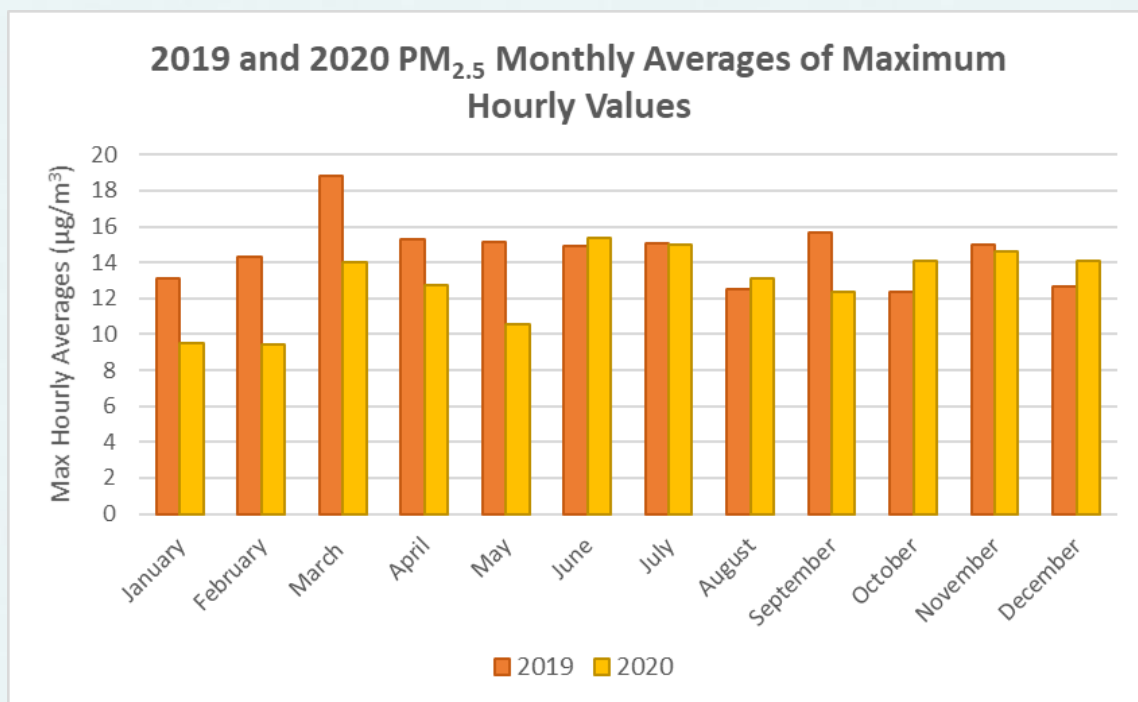
Figure 3. $PM_{2.5}$ monthly averages, 2019 and 2020

References: https://www.ajc.com/news/business/hartsfield-jacksons-passenger-traffic-declined-more-than-60-in-2020/5NO4HIIT4ZCM3OCEJMGTXLC7RU/
https://www.tomtom.com/en_gb/traffic-index/atlanta-traffic/

The Air Quality Index (AQI) values indicate the level of air quality. The values can range from 0-500 (refer to the AQI Section on page 51 for more detail). When the air quality is labeled in the "Good" category, there is little to no risk for humans. When the air quality is in the 'Unhealthy for Sensitive Groups", "Unhealthy", and "Very Unhealthy" categories, people in sensitive groups may experience health effects. For AQI, in the Atlanta MSA, the month of September had the greatest percent difference of 70.6%.

Figure 4. AQI monthly averages, 2019 and 2020
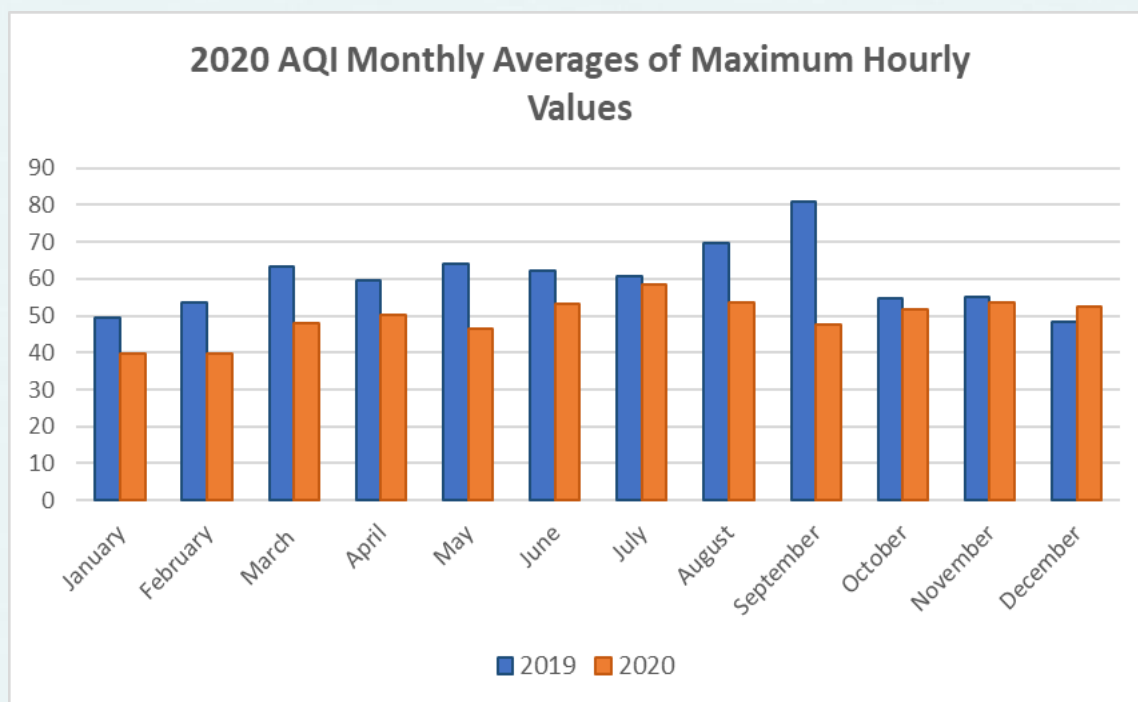
NO$_2$ is usually formed during combustion from mobile sources, as well as from industrial sources. High NO$_2$ levels can affect individuals with asthma and lung diseases. For NO$_2$, in the Atlanta MSA, the month of September had the greatest percent difference of 45.7%.

Figure 5. NO$_2$ monthly averages, 2019 and 2020
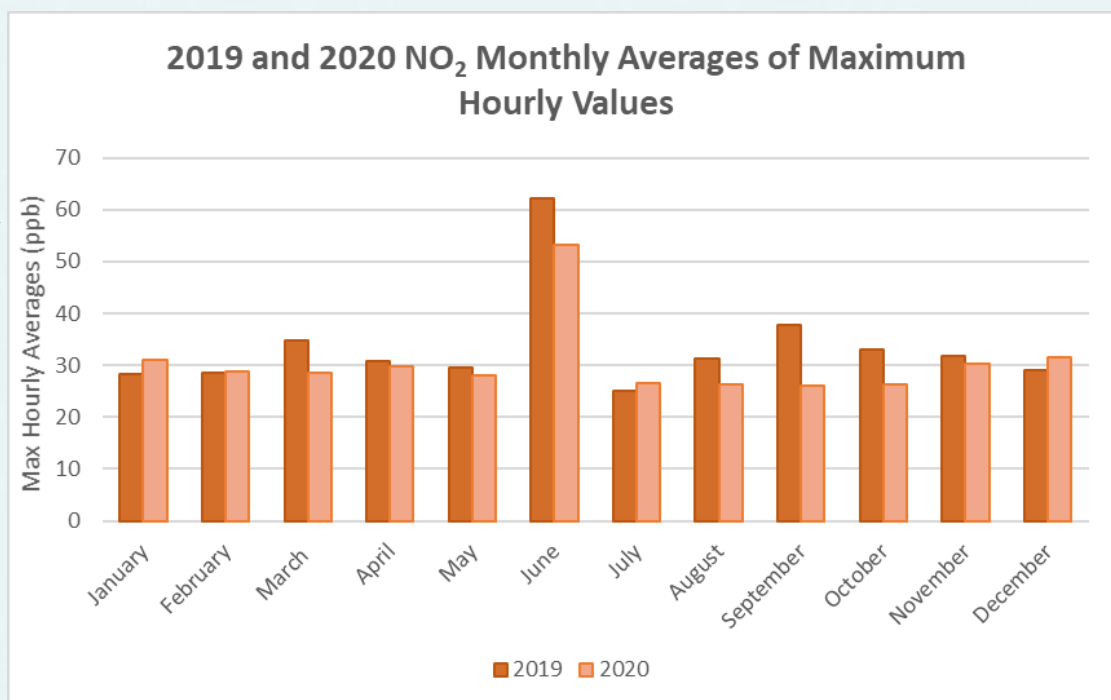
Overall, the Atlanta MSA saw decreases in the ozone, PM$_{2.5}$, NO$_2$ and AQI values from 2019 to 2020. With some businesses and industries at lower production and wetter, cooler weather, and less transportation being utilized, there was an overall reduction in air pollution in the Atlanta MSA, especially in the late Winter and Spring.

References: https://www.ajc.com/news/business/hartsfield-jacksons-passenger-traffic-declined-more-than-60-in-2020/5NO4HIIT4ZCM3OCEJMGTXLC7RU/
https://www.tomtom.com/en_gb/traffic-index/atlanta-traffic/

Voluntary Emissions Reductions Programs– GA EPD Partners

Encouraging fewer vehicles on the road...

http://gacommuteoptions.com/

- Sponsored by the Atlanta Regional Commission (ARC).

- Distributes daily ozone forecasts (as well as $PM_{2.5}$ forecasts) produced by EPD and Georgia Tech during the ozone season to enable citizens in the sensitive group category, as well as industries, to alter activities on days that are forecasted to have high ozone levels.

- Distributes smog alerts for the Atlanta metropolitan area.

- Rewards commuters for trying an alternative to driving alone to and from work (e.g. carpooling or utilizing transit).
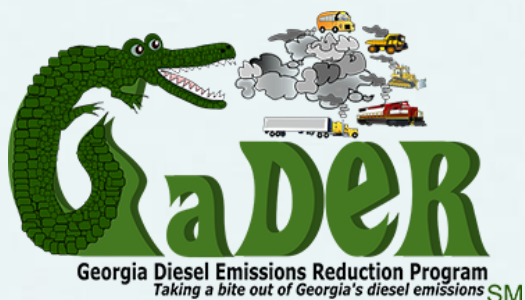
With a focus on reducing all sources of diesel emissions in Georgia, the GADER program not only encompasses the Georgia School Bus Retrofit initiative, but also assists with funding, and education assistance and outreach for voluntary measures such as idling reduction, Truck Stop Electrification, the use of cleaner fuels, and diesel emissions controls to rail yards, long haul and delivery truck fleets, construction equipment, and more.

Helping schools afford cleaner school buses...

- Older diesel school buses are replaced early, and the newer buses come equipped with an emissions control device to reduce emissions of oxides of nitrogen (NO_X).

- Selective catalytic reduction (SCR) is an emissions reduction technology used in diesel engines to convert NO_X pollution into harmless atmospheric nitrogen and water. The technology is enhanced when the engines run on low sulfur diesel fuel, the dominant fuel today.

- Diesel powered commercial trucks can add particulate trap filters to capture particulate matter pollution exhausted from their engines.

Encouraging the use of alternative fuels...

Helping promote Truck Stop Electrification Stations...

- Diesel powered commercial trucks can produce emissions of oxides of nitrogen (NO_X) due to idling. Truck drivers are typically required to rest 8 hours for every 10 hours of travel time and their diesel engines are often idled during rest times to power air conditioning and heating systems.

- Truck stop electrification allows truck drivers to run their air conditioning, heating, electronic devices without having to run their diesel powered engines.

- Cool and warm air can be pumped into the trucks via a hose hookup at the electrified truck stops.

Working to reduce locomotive and rail yard emissions...

- Locomotives were retrofitted with cleaner technology to help improve air quality.

- Argos completed 1 "genset" conversion. The genset uses two smaller TIER 4 diesel engines that replaces one large older diesel engine. The new genset may be operated with just one engine or both engines depending on the power demand thereby improving efficiency.

- CSX completed 9 (TIER 3) conversions using in-cylinder strategies including improved fuel injection, inlet air cooler and rings along with an improved oil separator for crank case ventilation.

- Norfolk Southern completed 41 conversions. 25 locomotives were converted to Mother locomotives that use TIER 3 in cylinder strategies. 16 locomotives were converted into slugs.

- 'Mother'-'Slug' sets operate in tandem. A Mother locomotive generates electricity using a diesel engine. The electricity is used to power electric traction motors on both the Mother and Slug. The slug has no diesel engine, so it relies on electrical power from the Mother.

- Norfolk Southern installed electrical plugin stations used to power electric block heaters that prevent coolant water from freezing during the winter, which minimizes the need to idle diesel engines.

NORFOLK SOUTHERN®

41 LOCOMOTIVES CONVERTED INTO 25 MOTHERS AND 16 SLUGS

CSX TRANSPORTATION

9 CONVERSIONS

GaDER Georgia Diesel Emissions Reduction Program

ARGOS

1 LOCOMOTIVE CONVERTED INTO A TIER-4 GENSET

Air Quality in Georgia

Pollutants of Concern and Their Sources in Georgia

The list below shows the most common air pollutants in Georgia by percentage and their sources as found in the 2017 National Emissions Inventory (NEI). Across the state of Georgia, miscellaneous construction and farming equipment, on-road mobile sources including vehicles, non-road mobile sources including aircraft and boats, stationary sources, and emissions from vegetation contribute the most to pollution in Georgia.

Particulate matter 2.5 PM$_{2.5}$: 57%, 22%, 7%, 6%, 2%, 2%, 4%

Particulate matter 10 PM$_{10}$: 75%, 12%, 5%, 2%, 3%, 2%, 1%

Volatile organic compounds VOCs: 79%, 6%, 4%, 4%, 2%, 2%, 1%, 1%

Sulfur dioxide SO$_2$: 55%, 20%, 10%, 8%, 3%, 2%, 2%

Nitrogen oxides NOx: 45%, 17%, 15%, 9%, 6%, 4%, 4%, 1%

Carbon monoxide CO: 33%, 25%, 15%, 15%, 6%, 3%, 1%, 2%

Lead Pb: 75%, 23%, 2%
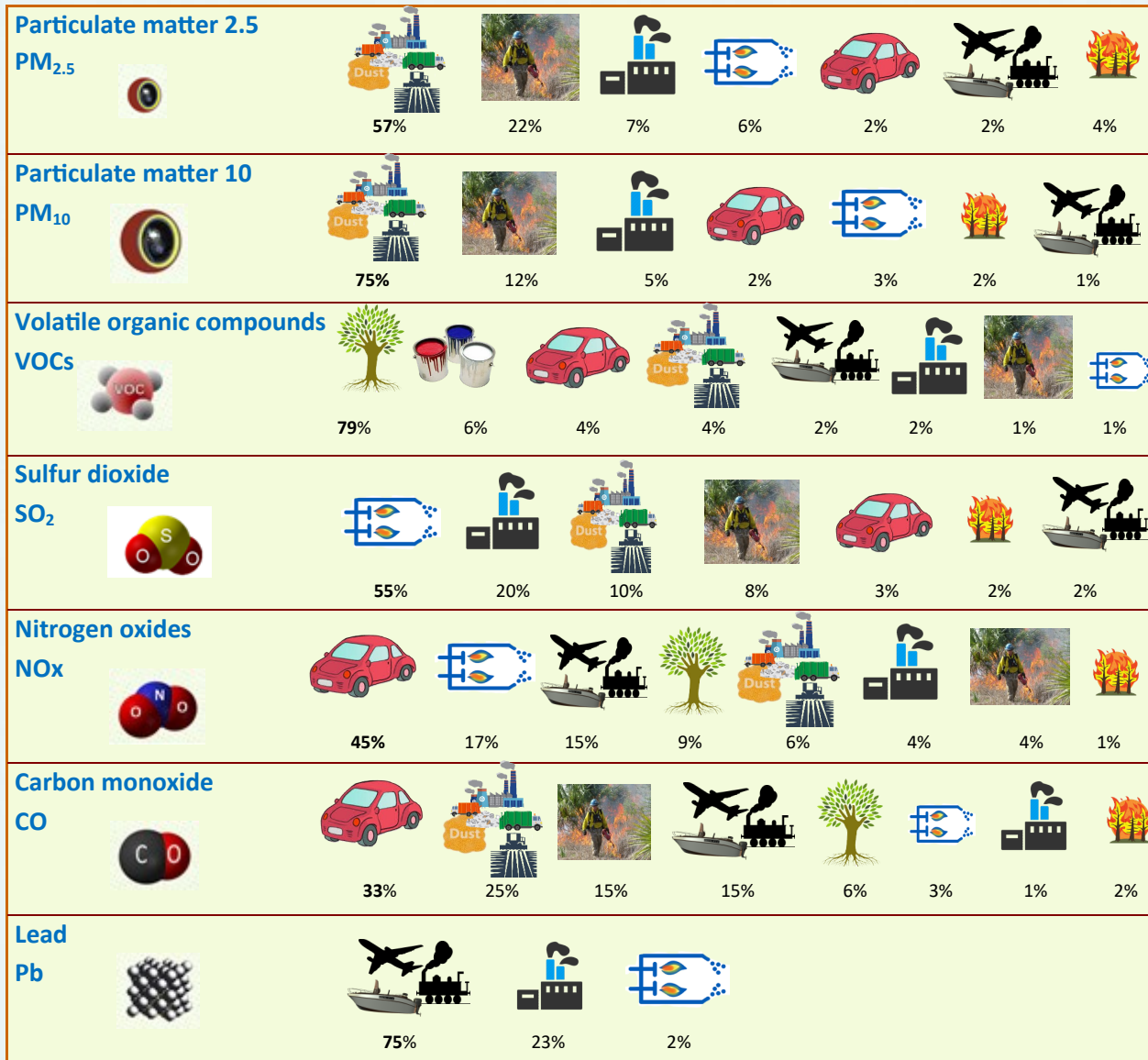
*CO is more of a concern for indoor air quality than it is for outdoor air quality.

Key:

On-road Mobile | Off-road Mobile | Industrial Processes | Fuel Combustion (EGU)/ Other | Prescribed Fire | Wildfires | Miscellaneous | Biogenics | Solvent

Figure 6. Pollutants of Concern and Their Sources in Georgia

Source: 2017 National Emissions Inventory

Emissions Trends in Georgia

The sources of pollutants seen on the previous page were assembled into seven categories for the following graphs. The major contributors for CO and NO_x are highway vehicles, while the largest contributors of SO_2 are electric utilities. Wildland and prescribed fires can have a large impact on $PM_{2.5}$ emissions, and VOCs come from a variety of stationary sources. There is a downward trend shown here for all emissions from 2010 through 2020. In 2011, there was a wildfire in the Okefenokee Swamp area that showed an uptick in the data for that year.

Georgia's air quality is improving...
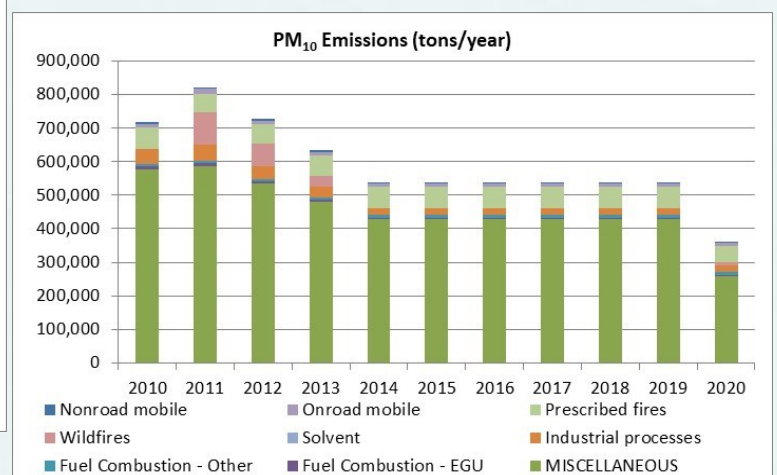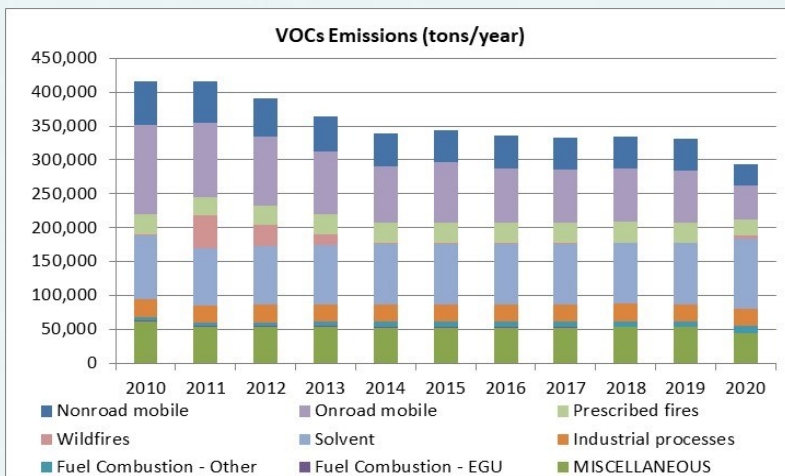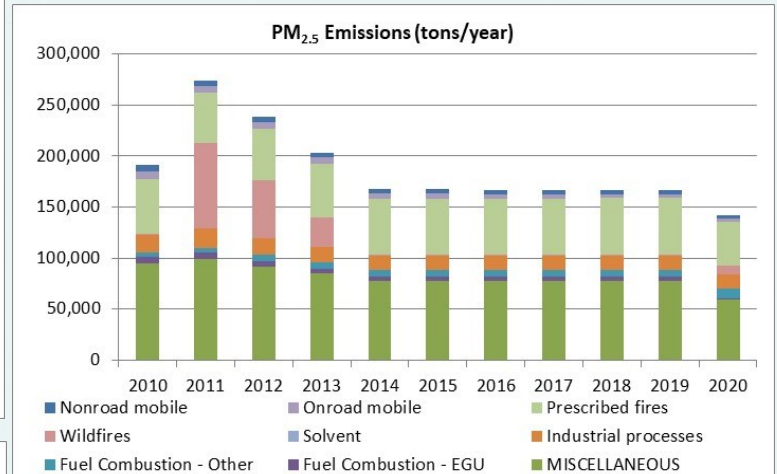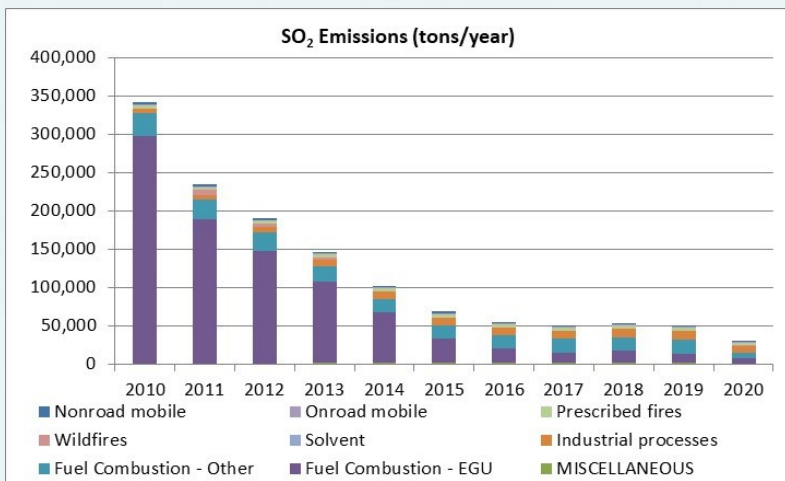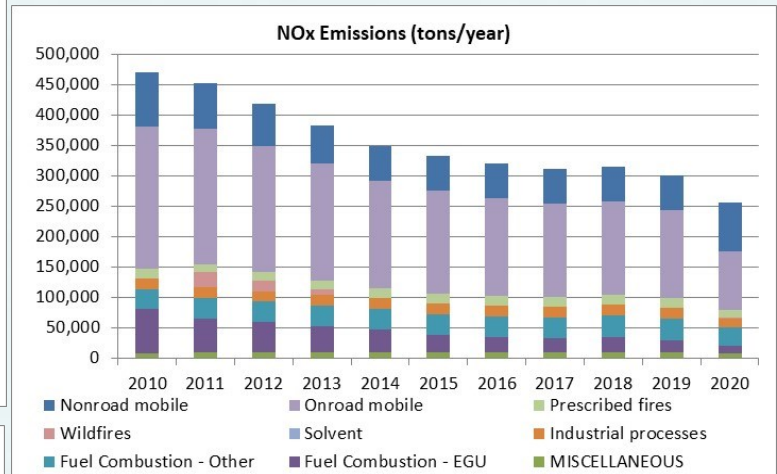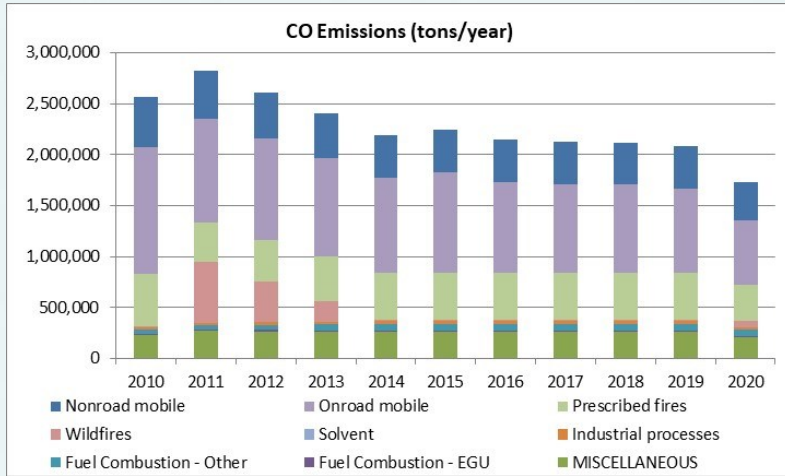
Figure 7. Emissions Trends in Georgia

Georgia's Ambient Air Monitoring Sites
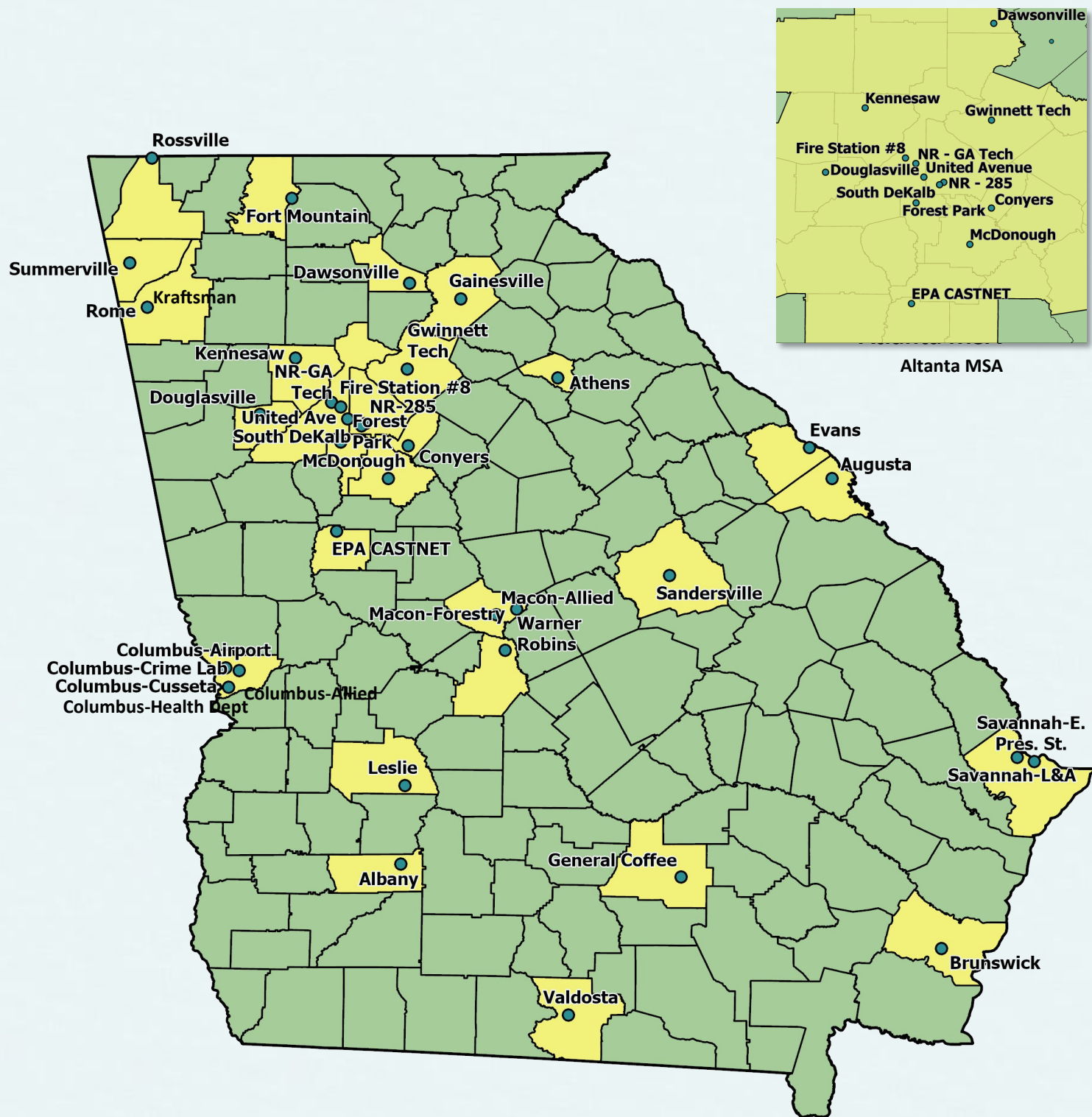
Figure 8. Georgia's ambient air monitoring sites

For more detailed site information, see page 72.

Criteria Pollutants (six most common regulated pollutants)

The Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to identify pollutants that may endanger public health or welfare. Under the CAA, the EPA sets **National Ambient Air Quality Standards (NAAQS)** for six common air pollutants, also referred to as "criteria" pollutants based on the current science regarding their known health effects. The NAAQS are divided into primary standards that protect public health and secondary standards that protect the public welfare and environment. EPA reviews the NAAQS periodically, based on new findings about the health effects of air pollution. For more information about the NAAQS, please refer to EPA's website (https://www.epa.gov/criteria-air-pollutants/naaqs-table).

NAAQS have been established for six common air pollutants called criteria pollutants:

Carbon Monoxide (CO)

Oxides of Nitrogen (NO$_2$)

Sulfur Dioxide (SO$_2$)

We monitor for these criteria pollutants and much more. Our monitoring network takes the guess work out of knowing what pollutants are in the air you breathe.

Ozone (O$_3$)

Lead (Pb)

Particulate Matter (PM)
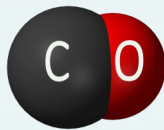
Carbon Monoxide (CO)

What is it?

- Carbon Monoxide is an odorless, colorless, and poisonous gas that is a by-product of incomplete burning.

  Learn more: https://www.epa.gov/co-pollution

Where does it come from?

- Carbon and oxygen can combine to form two different gases. When combustion of carbon is complete, in the presence of plenty of air, the product is mainly carbon dioxide (CO_2). Sources of carbon include; coal, coke, charcoal. When combustion of carbon is incomplete, *i.e.* there is a limited supply of air, only half as much oxygen adds to the carbon, and instead you form carbon monoxide (CO).

- In Georgia, 48% of the carbon monoxide comes from mobile sources including cars, construction equipment, aircraft, locomotives, and on the coast commercial marine vessels.

33%	25%	15%	15%	6%	3%	1%	2%

See page 23 for icon key.

Health Impacts

- Increased risk of lower blood flow, anemia, and reduced heart activity.

- Sensitive groups include fetuses, young infants, pregnant women, elderly people, and individuals with anemia or emphysema.

Georgia Monitoring Information for CO
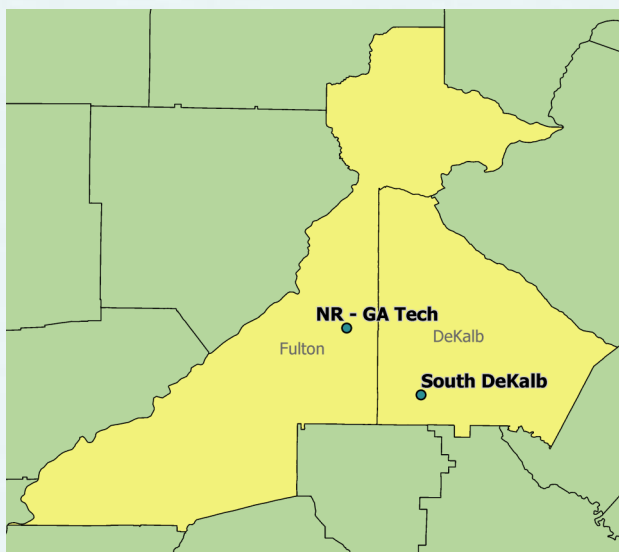
Figure 9. Georgia carbon monoxide monitoring sites

Measurement Technique

Measured continuously with infrared light[1]

MORE INFORMATION ABOUT MEASUREMENT TECHNIQUE

1 https://www.thermofisher.com/order/catalog/product/48I

National Ambient Air Quality Standards for Carbon Monoxide

Primary NAAQS: 8-hour average not to exceed 9 ppm more than once per year

1-hour average not to exceed 35 ppm more than once per year

Secondary NAAQS: None

Attainment Designation

All of Georgia is in attainment of both the 8-hour and 1-hour standards for carbon monoxide. Figure 10 shows how Georgia's CO compares to the 8-hour NAAQS.
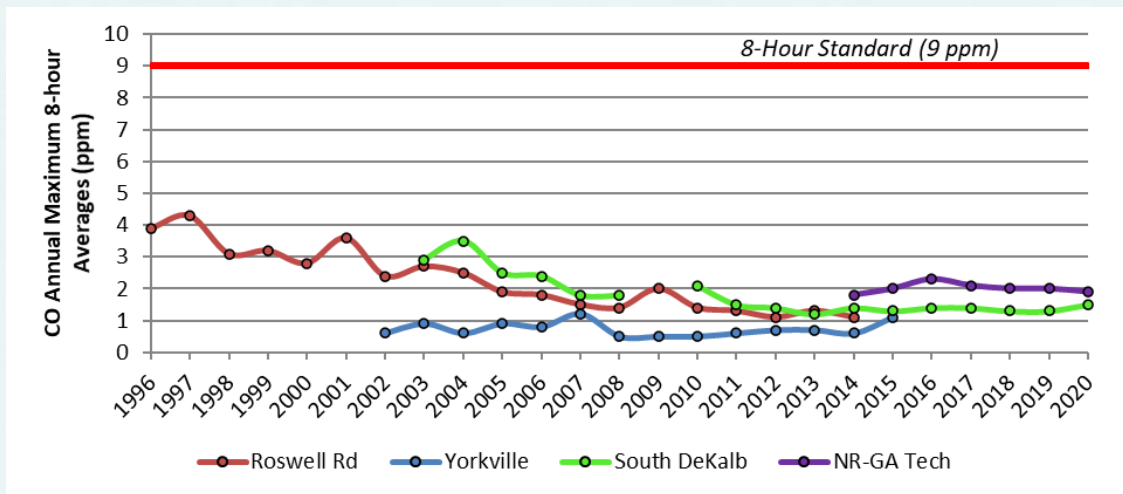
Figure 10. Carbon monoxide annual 8-hour average compared to the 8-hour standard

Figure 11 shows a comparison of CO values hourly, daily, monthly and day of the week for the NR-GA Tech and South DeKalb sites. The NR-GA Tech site, shown in purple, is located directly beside a highly trafficked interstate, while the South DeKalb site is about 1 mile away from the interstate.
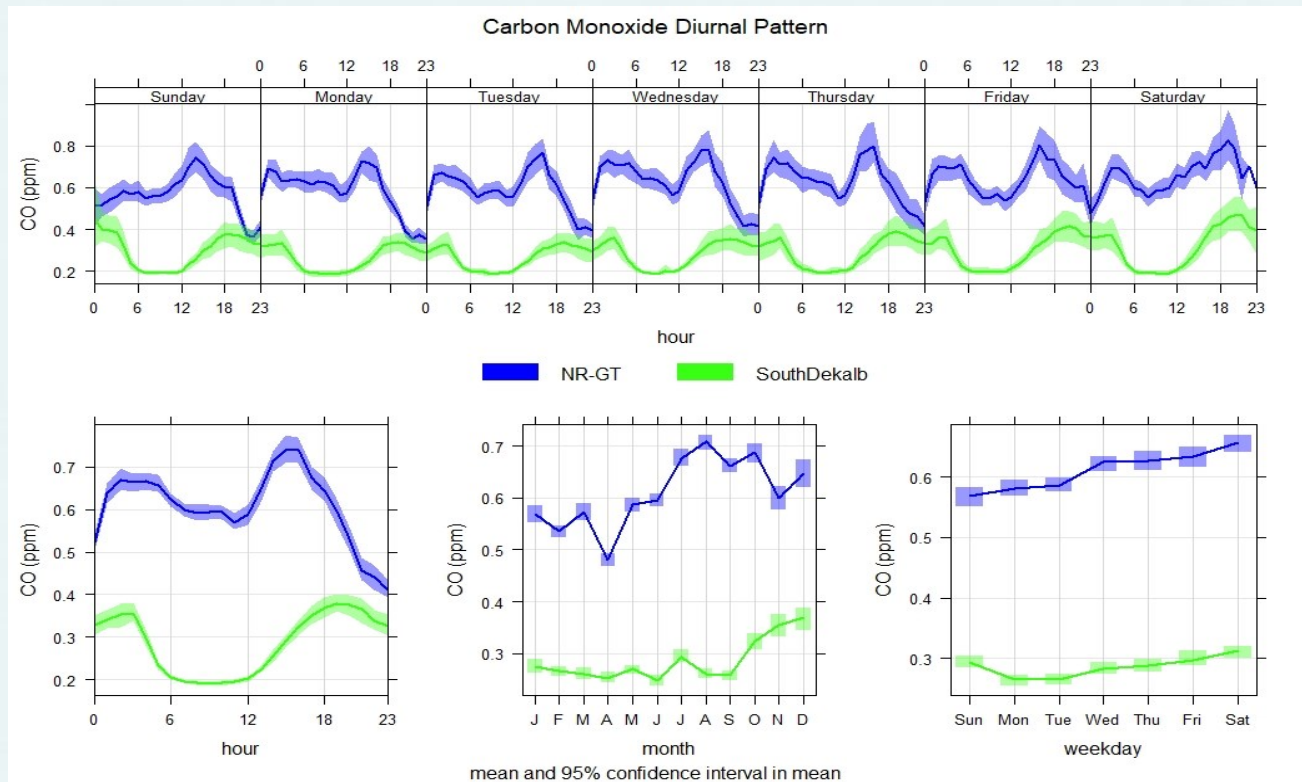
Figure 11. Carbon monoxide diurnal pattern for NR-GA Tech and South DeKalb sites

Oxides of Nitrogen (NO, NO$_2$, NO$_x$ and NO$_Y$)

NO   NO$_2$

What is it?

- Oxides of nitrogen are a mixture of gases that are composed of nitrogen and oxygen and primarily produced during combustion.   Learn more: https://www.epa.gov/no2-pollution

Where does it come from?

- Nitrogen oxides (NO$_x$) are usually products of combustion from mobile sources such as vehicle engines and construction equipment engines. They also come from large industrial boilers, turbines, and kilns, as well as fires. In Georgia, 45% of NOx comes from vehicles.

- NO$_2$ is formed from the oxidation of nitric oxide (NO).

- NO$_Y$ consists of all atmospheric reactive nitrogen oxide compounds.

| 45% | 17% | 15% | 9% | 6% | 4% | 4% | 1% |
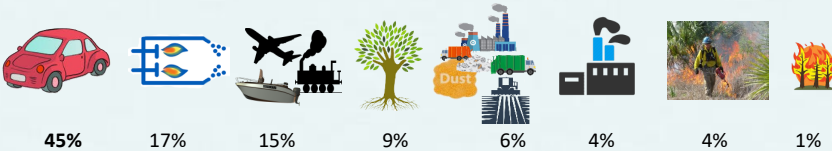
See page 23 for icon key.

Health Impacts

- Increases risk of respiratory infections, respiratory diseases and asthma

KNOW YOUR NITROGEN OXIDES

Air pollution has been in the news with the recent Volkswagen scandal, which has included a lot of talk of nitrogen oxides. Here's a guide to which is which!

NO$_x$ — NITROGEN OXIDES

The x represents a number: either 1 (for nitric oxide) or 2 (for nitrogen dioxide). Both are produced by vehicles. Nitrous oxide isn't included in this generic term.

NO — NITRIC OXIDE

Air pollutant formed by high temperature oxidation of nitrogen in air. It reacts with atmospheric oxygen to form nitrogen dioxide, and can also deplete ozone.

NO$_2$ — NITROGEN DIOXIDE

Prominent air pollutant. It helps generate ground-level ozone, which affects human health, causes crop damage, and acts as a potent greenhouse gas.

N$_2$O — NITROUS OXIDE

Also known as 'laughing gas', and used as an anaesthetic. It's used in racing engines to increase power, and is also produced by catalytic converter processes.

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Source: http://www.compoundchem.com/2015/09/30/vehicle-emissions/

Georgia Monitoring Information for Oxides of Nitrogen

NR - GA Tech

Fulton   DeKalb

NR - 285

South DeKalb

Figure 12. Georgia's NO/NO$_2$/NO$_x$ monitoring sites (green circles) and NO$_Y$ site (red square)

Measurement Technique

Measured continuously with a chemiluminescent method[2].

MORE INFORMATION ABOUT MEASUREMENT TECHNIQUE

[2] https://www.thermofisher.com/order/catalog/product/42I

NOₓ Daily Cycle

NOₓ reacts with volatile organic compounds in the presence of sunlight to form ground level ozone (O_3) pollution which causes NOₓ levels to drop in the middle of a sunny day and increase at night on a daily basis. Because this pattern typically reoccurs each day within a 24-hour period, this is known as a diurnal cycle.

The following graph shows a comparison of the daily average of hourly NO_2 data at the near-road sites, NR-285 and NR-Georgia Tech, compared to the South DeKalb NO_2 site. The two near-road sites (shown in green and red) display the highest daily averages.

(Courtesy of Jamie Smith)
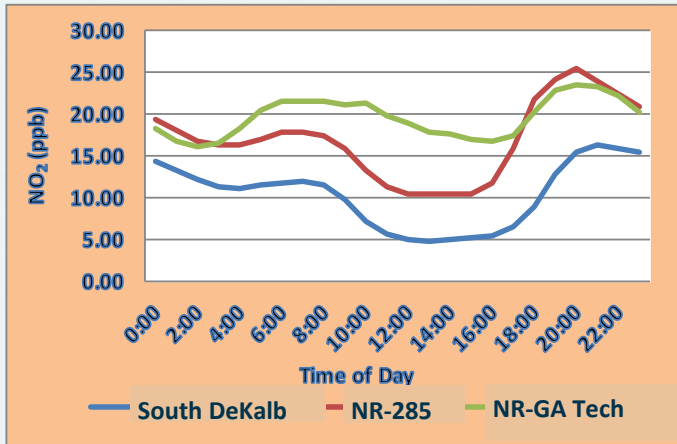
Figure 13. Average diurnal pattern of NO_2
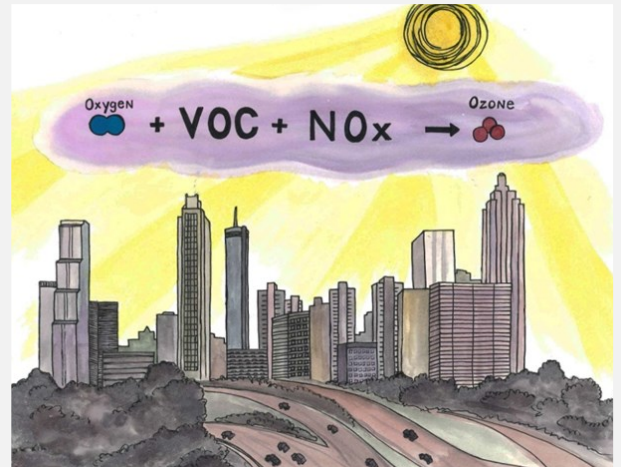
The South DeKalb site collects $NO/NO_2/NO_x/NO_Y$. In the next depiction, all 4 of these pollutants are compared for hourly averages, daily averages, day of the week averages, and monthly averages. NO_2 values (shown in red) trend between the NO_x and NO values. On this scale, NO_Y values are miniscule and are shown as the black line near 0 ppb.
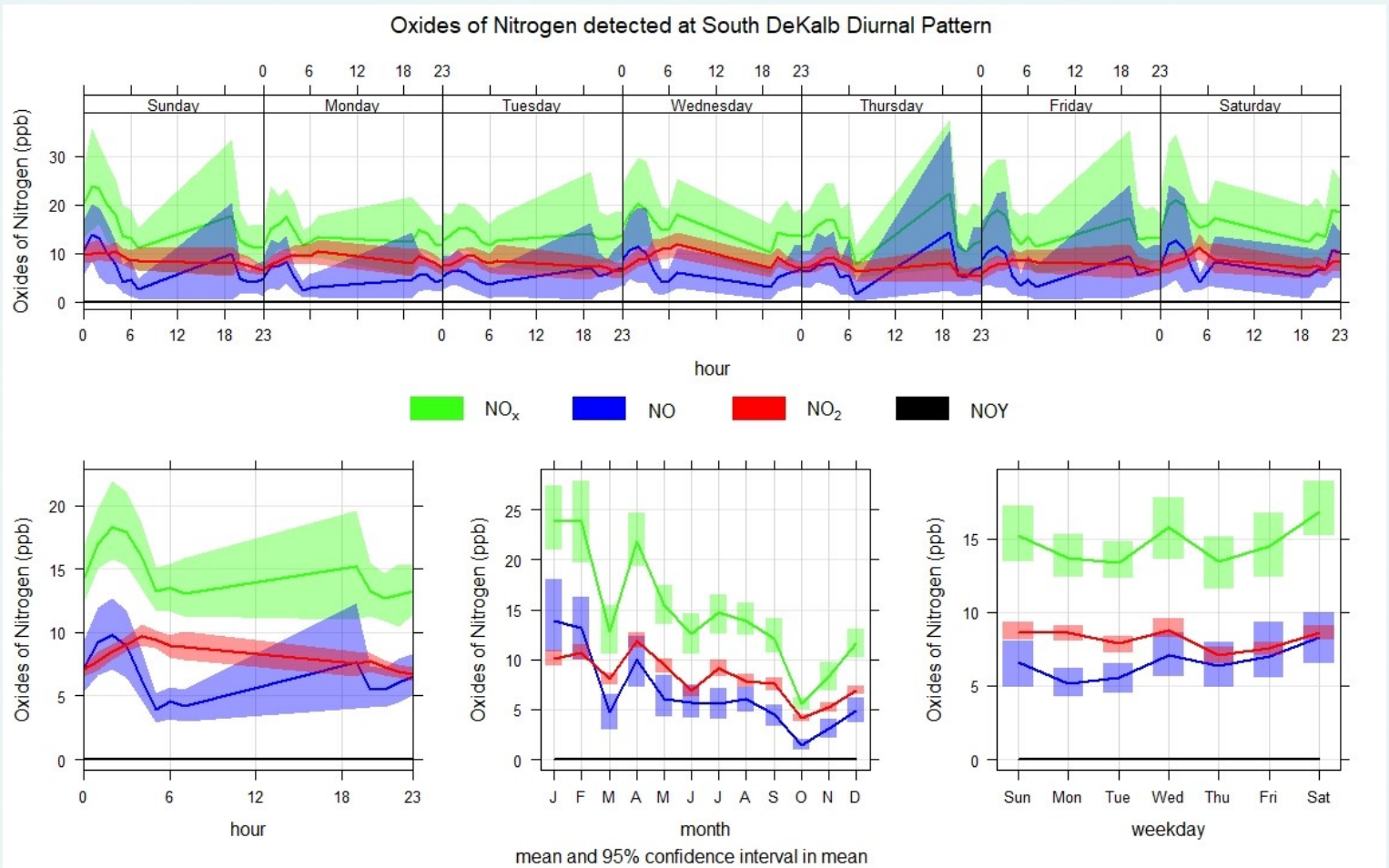
Figure 14. South DeKalb $NO/NO_2/NO_x/NO_Y$ diurnal comparison for 2020

Reducing NOₓ Emissions in Georgia

Ozone formation in the southeastern United States is driven by emissions of nitrogen oxides (NO_x) in large urban areas with high vehicle traffic. Therefore, Georgia has focused efforts on reducing the emissions of NO_x, particularly in the Atlanta ozone nonattainment area.

- Our vehicle emissions inspection program, also known as Georgia's Clean Air Force, which covers the counties of Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale, helps reduce NO_x, the main precursor to ozone.

- A series of Georgia air quality rules were implemented in 1999 through 2014 specifically targeting NO_x emissions from combustion sources such as industrial boilers and electric steam generating units at power plants, especially large coal-fired units. Figure 15 shows how NO_x pollution in Georgia declined as NO_x controls were implemented at large stationary sources from 1999 through 2014. The Georgia multi-pollutant rule, implemented 2008-2014, required additional NO_x reductions at power plants in addition to reductions in mercury and sulfur dioxide emissions. During the same time, national manufacturing standards required greater efficiency and performance from engines in vehicles, construction equipment, and generators which also helped reduce NO_x emissions nationwide, including Georgia.
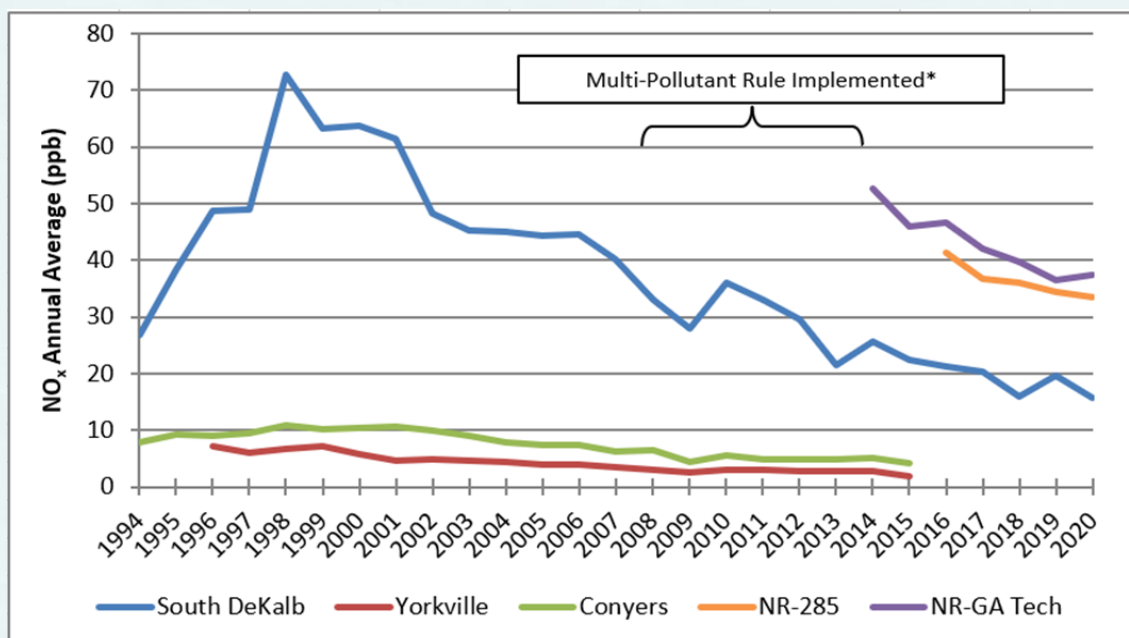
*Multi-pollutant Rule is discussed on page 27.

Figure 15. Implementation of NO_x Controls

National Ambient Air Quality Standards for Nitrogen Dioxide

Primary NAAQS: Annual mean must not exceed 53 ppb

                                  3-year average of the 98th percentile of daily maximum one-hour averages must not exceed 100 ppb

Secondary NAAQS: Annual mean must not exceed 53 ppb

Attainment Designation

- NO$_2$ monitoring is required in urban areas with populations exceeding one million. The Atlanta-Sandy Springs-Roswell Metropolitan Statistical Area (MSA) is the only urban area in Georgia required to perform NO$_2$ monitoring.
- Figure 16 shows Georgia's annual average NO$_2$ concentrations from 2000 to 2020. Annual average concentrations are well below the standard of 53 ppb.
- EPD operates two near-road monitoring sites (NR-GA Tech and NR-285) to study the effects of traffic pollution.
- Figure 17 indicates that Georgia's 1-hour design values are well below the 100 ppb national standard.
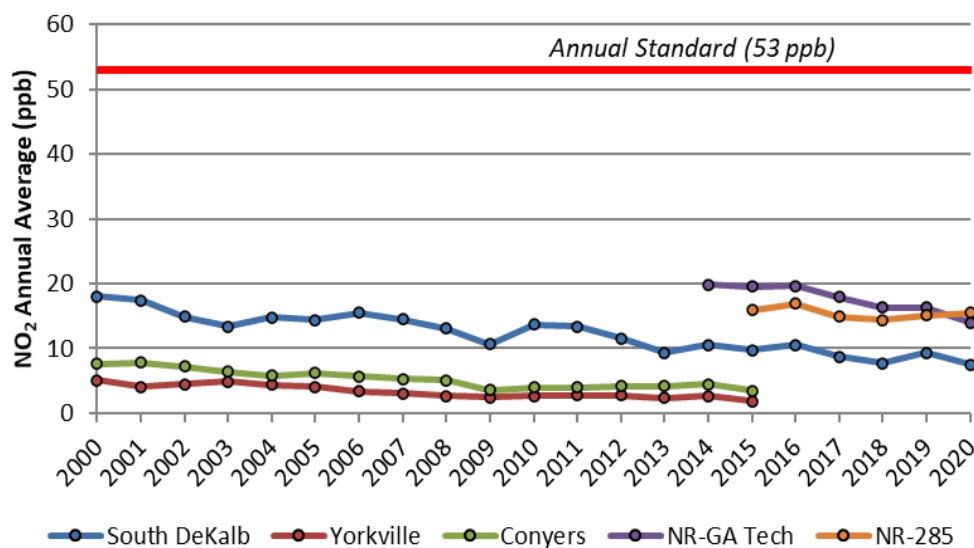
Figure 16. Nitrogen dioxide annual averages compared to the annual standard
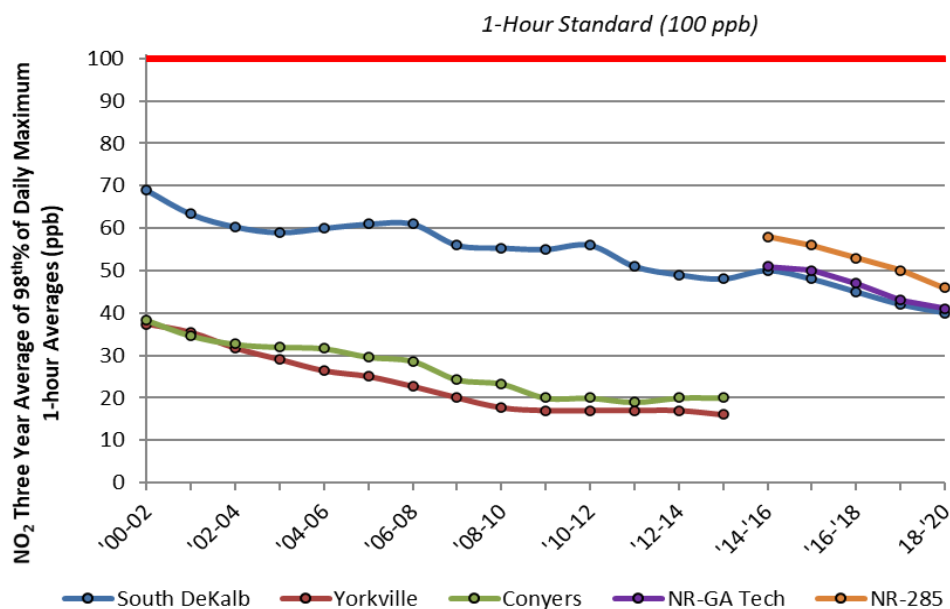
Figure 17. Nitrogen dioxide 1-hour design values compared to the 1-hour standard

Sulfur Dioxide (SO₂)

What is it?

- Sulfur dioxide (SO_2) is a colorless reactive gas that is formed by burning sulfur-containing material, such as coal or diesel fuel, or by processing sulfur-containing clays. Learn more: https://www.epa.gov/so2-pollution

Where does it come from?

- 85% of SO_2 emissions in Georgia come from industrial processes and fuel combustion (electric generation).
- SO_2 can be oxidized in the atmosphere into sulfuric acid, and form acid rain.
- Sulfur is oxidized to form SO_2 during combustion. SO_2 then can react with other pollutants to form aerosols, which are solid or liquid particles in a gas. SO_2 can also form sulfate particles, that contribute to the formation of fine particulate matter ($PM_{2.5}$).
- SO_2 may be found in clouds, fog, rain, aerosol particles, and in surface liquid films on these particles.

| 55% | 20% | 10% | 8% | 3% | 2% | 2% |

See page 23 for icon key.

Environmental Impacts

Both SO_2 and NO_2 can form acid rain that lead to acidic deposition[3].

Health Impacts

- SO_2 can impair respiratory function, increase respiratory disease, and reduce lung's ability to clear foreign particles especially in sensitive groups like children, the elderly, and individuals with asthma, hyperactive airways, and cardiovascular disease.
- Short-term peak exposures can cause significant constriction of air passages in sensitive asthmatics, wheezing, shortness of breath, and coughing in these sensitive groups, and affect ability to perform exercise.

Georgia Monitoring Information for Sulfur Dioxide (SO₂)

Floyd
Kraftsman
Fulton DeKalb
United Avenue South DeKalb
Augusta
Richmond
Macon - Forestry
Bibb
Savannah - E. President
Savannah - L&A Chatham

Figure 18. Georgia's sulfur dioxide monitoring sites
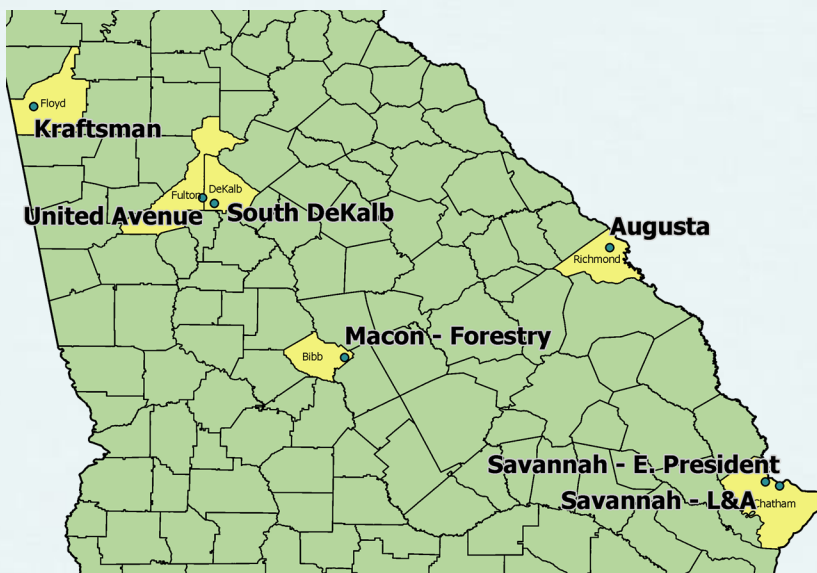
Measurement Technique

Continuous ultraviolet fluorescence[3]

MORE INFORMATION ABOUT MEASUREMENT TECHNIQUE

[3] https://www.thermofisher.com/order/catalog/product/43I

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[3]Acid deposition causes damage to forests, man-made structures, and streams and lakes, which can be deadly for aquatic wildlife.

Reducing SO₂ in Georgia

Georgia's Multi-Pollutant Rule

- In 2007, Georgia implemented State Rule 391-3-1-.02(2)(sss), which affects the 13-county Atlanta nonattainment area plus surrounding counties.
- This multi-pollutant control measure for electric steam generating units at electric utilities required coal fired power plants to install controls to reduce three criteria pollutants, PM, NO_2, and SO_2, and had rolling start dates between 2008 and 2014.
- The controls are called Selective Catalytic Reduction (SCR) for NO_x and Flue Gas Desulfurization (FGD) for SO_2 and PM.
- Figure 19 shows the decrease in SO_2 concentrations as these controls have been implemented across the state.
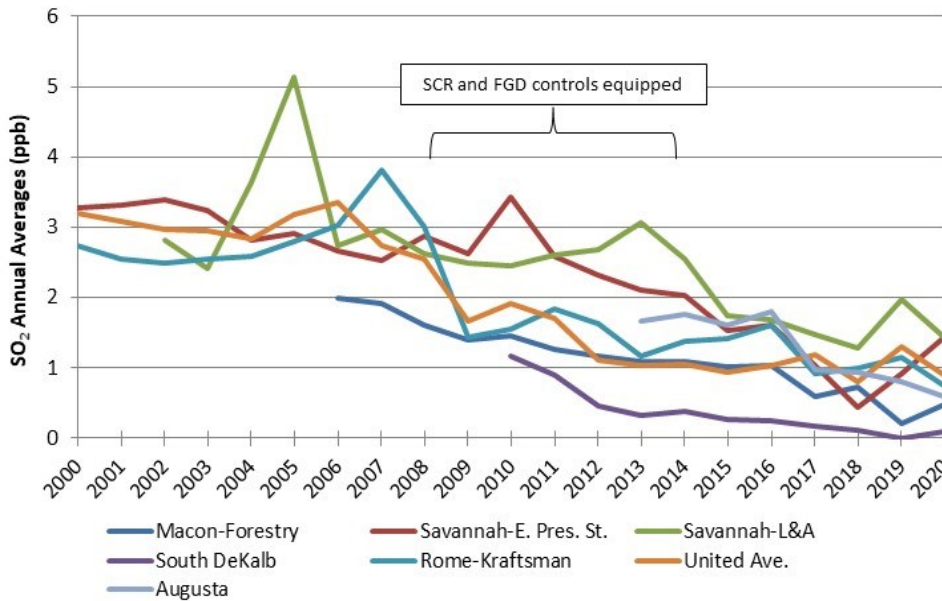
Figure 19. Implementation of SO_2 Controls

SO_2 and PM
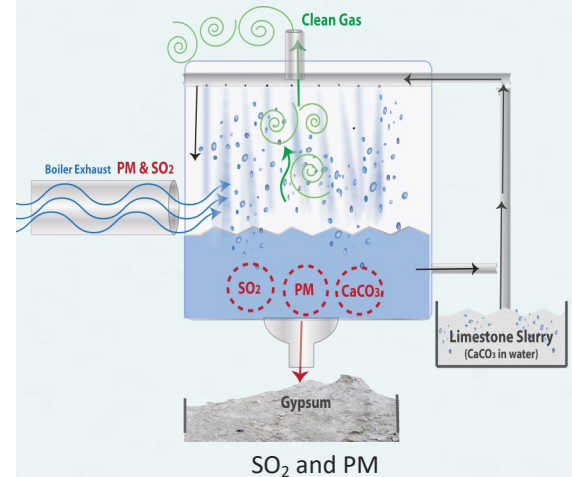
Figure 20. Schematic design of the absorber of an FGD

Statewide SO₂ Concentration Comparison from 2005 to 2020

- Figure 21 compares the concentrations of sulfur dioxide from 2005 and 2020 in Georgia on a scale of 0 to 5 in Dobson units (DU)[5].

- These maps were created by NASA using satellite data and depict averages of sulfur dioxide concentrations over the eastern United States.

2005

2020

Giovanni - Time Averaged Map (nasa.gov) https://giovanni.gsfc.nasa.gov/giovanni/
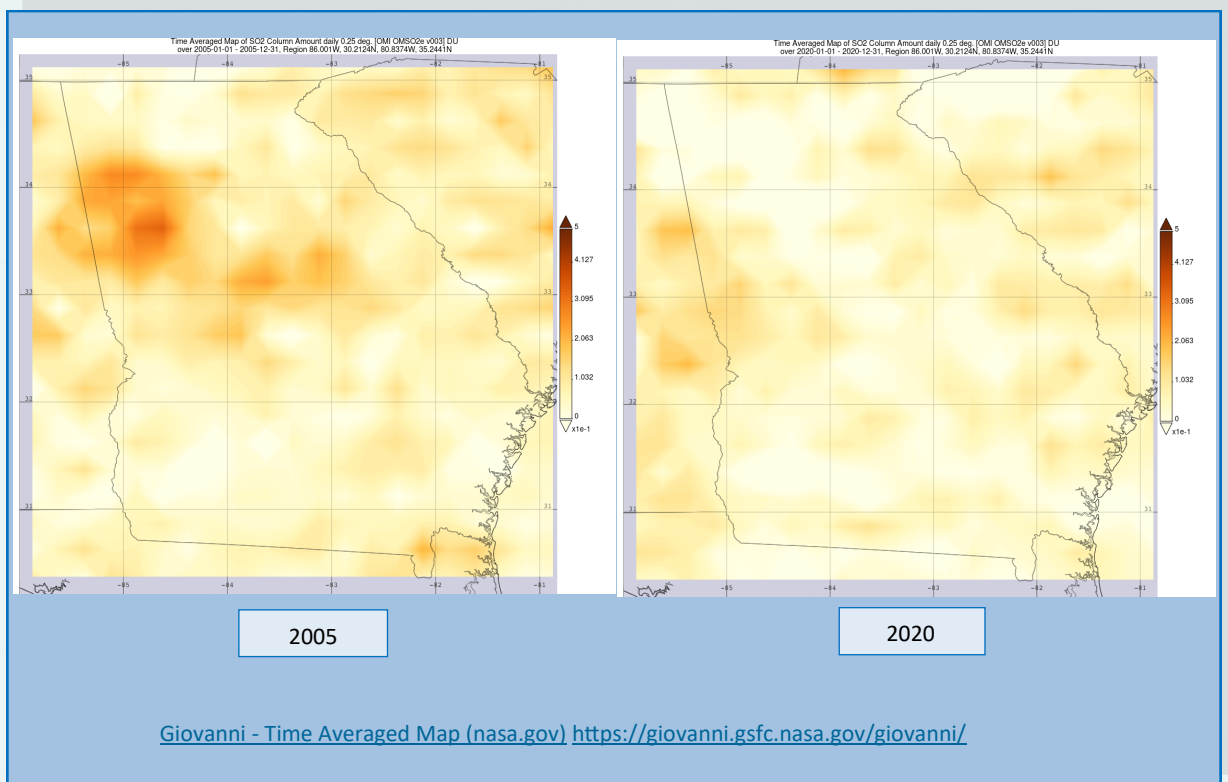
Figure 21. SO_2 Statewide Concentration Comparison from 2005 to 2020

[5] A Dobson unit (DU) is a measurement of density of a gas in a column of the Earth's atmosphere.

National Ambient Air Quality Standards for Sulfur Dioxide

Primary NAAQS: 3-year average of 99th percentile of the daily maximum 1-hour concentration not to exceed 75 ppb

Secondary NAAQS: 3-hour concentrations not to exceed 0.5 ppm (500 ppb) more than once per year

Attainment Designation

- EPA strengthened the SO_2 primary National Ambient Air Quality Standard (NAAQS) in 2010 and has developed a 4-phase process for designations. Please refer to EPA's information on the SO_2 data requirement rules for more details[6].

- All the SO_2 design[7] values, for 2017-2019 in Georgia, were below the 1-hour standard, with the highest design value occurring at the Augusta site (52 ppb).
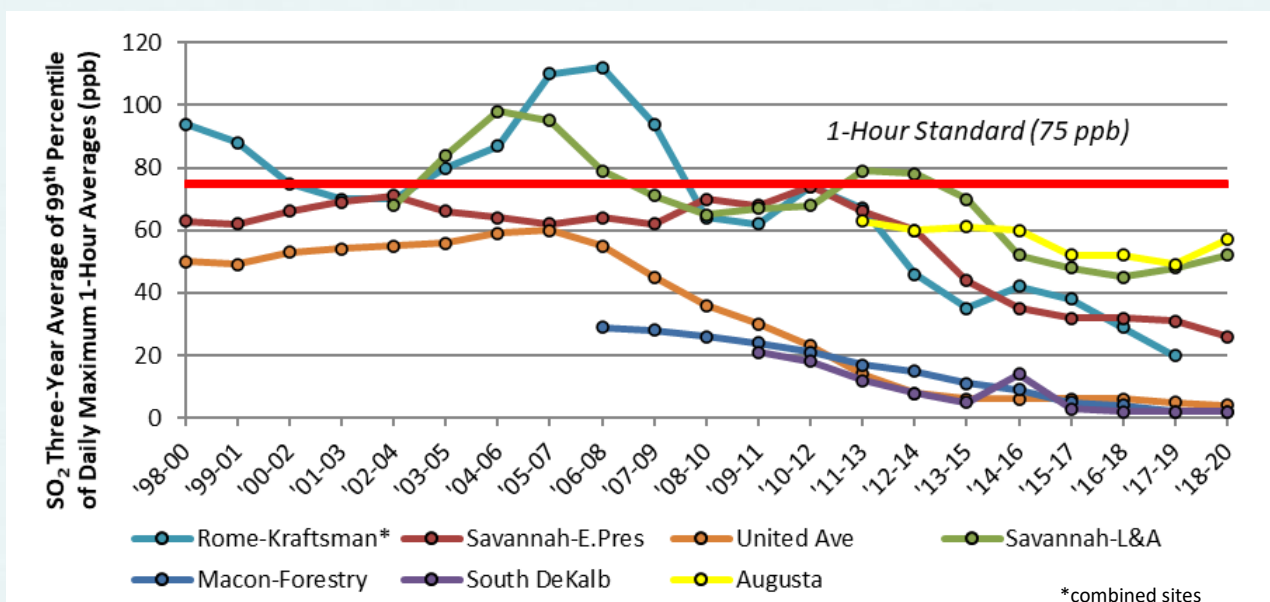
Figure 22. SO_2 three-year averages of the 99th percentile of annual daily max 1-hour averages

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[6]https://www.epa.gov/so2-pollution/final-data-requirements-rule-2010-1-hour-sulfur-dioxide-so2-primary-national-ambient

[7]Three-year average of the 99th percentile of annual daily maximum 1-hour averages

Ozone (O₃)

What is it?

Ozone is a form of oxygen. But unlike oxygen (O_2), ozone (O_3) is not a stable gas. Ozone is highly reactive and unstable - corrosive and capable of damaging living cells. Ground-level ozone can be harmful at high concentrations and is a regulated pollutant. NOTE: Ozone occurs naturally in the Earth's upper atmosphere (stratosphere) where it protects life on Earth from the sun's harmful ultraviolet (UV) rays. This is the good ozone. "Good Up High, Bad Nearby."
Learn more: https://www.epa.gov/ozone-pollution

Where does it come from?

Ground-level ozone is not emitted directly into the air, but is created by chemical reactions between nitrogen oxides (NO_x) and volatile organic compounds (VOC) in the presence of sunlight. Major sources of NO_x include emissions from industrial facilities, electric utilities and motor vehicle exhaust. In Georgia, the major sources of VOC are natural sources such as trees and vegetation. Other VOC sources include gasoline vapors and chemical solvents.
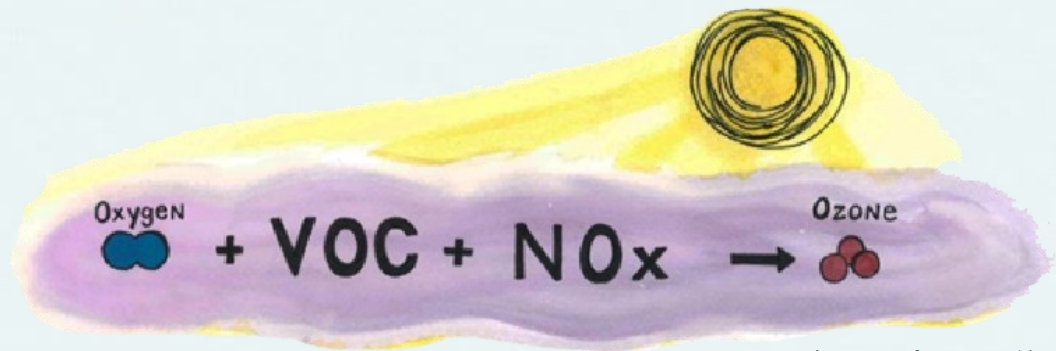
(Courtesy of Jamie Smith)

Figure 23. Ozone formation process

Health Impacts

- Ozone can irritate the mucous membranes of the nose, throat, and airways which can lead to coughing and chest pain.
- It can increase risk of respiratory infections in people with asthma and respiratory disease.
- Ozone reduces the ability to perform physical exercise by impairing normal lung function.
- Repeated exposure may cause permanent scarring of lung tissue.

Georgia Monitoring Information for Ozone
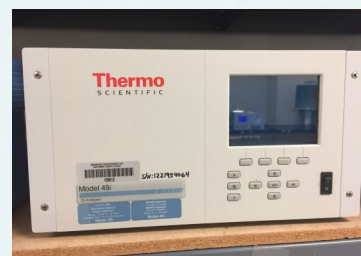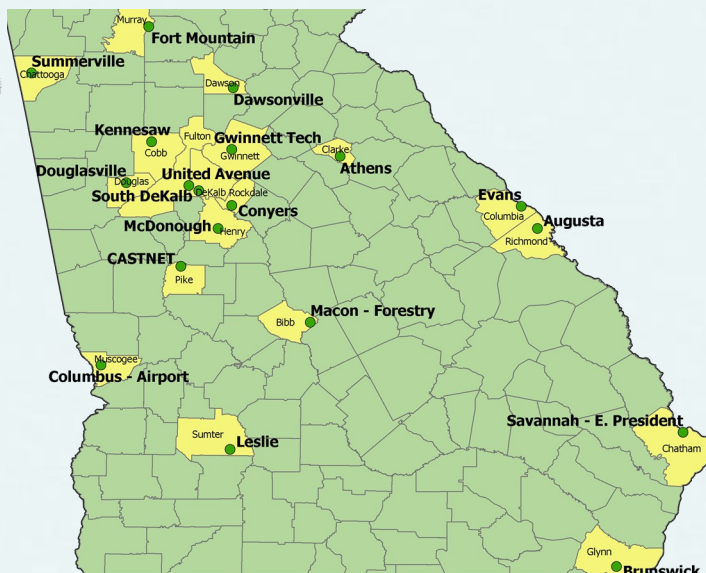
Measurement Technique

Continuous ultraviolet photometric method[4]

MORE INFORMATION ABOUT MEASUREMENT TECHNIQUE

[4] https://www.thermofisher.com/order/catalog/product/49I

Figure 24. Georgia's ozone monitoring sites

EPA's CASTNET Site

- As part of the Clean Air Status and Trends Network (CASTNET), EPA established a monitoring site in Pike County, Georgia in 1988.

- The CASTNET site is part of a national air quality monitoring network put in place to assess long-term trends in atmospheric deposition and ecological effects of air pollutants.

- The CASTNET site is one of 95 regional sites across rural areas of the United States and Canada measuring nitrogen, sulfur, and ozone concentrations, and deposition of sulfur and nitrogen.

- Like the South DeKalb ozone monitor, the CASTNET ozone monitor also collects data year-round. https://www.epa.gov/castnet

More Information about Ground Level Ozone

- Ground level ozone formation occurs through a complex series of photochemical reactions that take place in the presence of sunlight, causing a diurnal pattern (high ozone during the day, low ozone at night, see Figure 25).
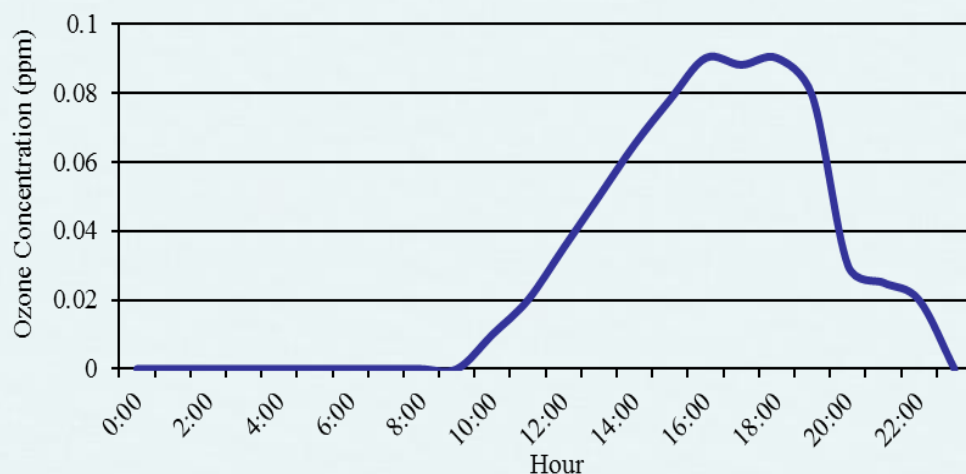
Figure 25. Typical urban 1-hour ozone diurnal pattern

- The photochemical reactions require a reaction between oxides of nitrogen (NO_x) and volatile organic compounds (VOCs).

- Since there will always be strong sunshine in the summer, and the naturally-occurring (or biogenic) levels of VOCs in Georgia are high, the most effective way to control ozone production in Georgia is to reduce emissions of NO_x in the summer.

- Examples of the most common reactive VOCs that contribute to ozone formation are: hydrocarbons found in automobile exhaust (benzene, propane, toluene); vapors from cleaning solvents (toluene); and biogenic emissions from plants and trees (isoprene). In Georgia, biogenic emissions account for 79% of the VOCs.

Volatile Organic Compounds VOCs

| 79% | 6% | 4% | 4% | 2% | 2% | 1% | 1% |

See page 23 for icon key.

- With the exception of the South DeKalb and CASTNET sites, ozone in Georgia, unlike other pollutants previously discussed, is monitored March through October, complying with federal monitoring regulations (in 40CFR Part 58). Ozone is prevalent in urban areas in the summer but can appear in other areas due to weather patterns that can move air for many hundreds of miles.

National Ambient Air Quality Standards for Ozone

Primary NAAQS: 3-year average of 4th highest daily maximum 8-hr concentration not to exceed 0.070 ppm

Secondary NAAQS: Same as the Primary Standards

Attainment Designation

- Ozone monitoring has been in place in the Atlanta area since the 1970's.

- Currently the Atlanta-Sandy Springs-Roswell MSA ozone network includes nine monitors located in nine counties.

- On March 27, 2008 the ozone primary standard level was lowered to 0.075 ppm for the 8-hour averaging time, fourth maximum value, averaged over three years (Federal Register, Vol. 73, No. 60, page 16436).

- With the implementation of this ozone standard, the boundary of the Atlanta nonattainment area was defined as a 15-county area.

- With the 2013-2015 ozone data, the entire state of Georgia (including Atlanta) met the 2008 ozone standard of 0.075 ppm for ozone.
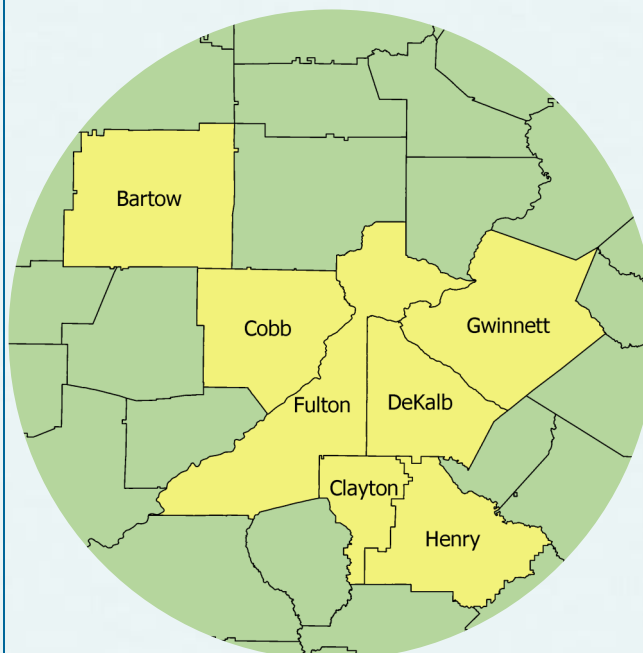
Figure 26. Georgia's 8-hour ozone nonattainment area (NAA) map for the 2015 standard

- Georgia was redesignated to attainment of the 2008 standard on May 22, 2017.

- On October 1, 2015, EPA lowered the ozone standard to 0.070 ppm[5].

- Then for this 2015 standard, and with the 2014-2016 data, the Atlanta area was redesignated to include only a 7-county area for the non-attainment area (Figure 26) (Federal Register, Vol. 83, No. 107, page 25776).

- A violation of the standard is determined by using an 8-hour average of the fourth maximum daily value, averaged over three years. There has been a gradual reduction in the number of days exceeding the ozone standards (Figure 27).

- The Atlanta area attained the 2015 ozone standard with the 2018-2020 data.
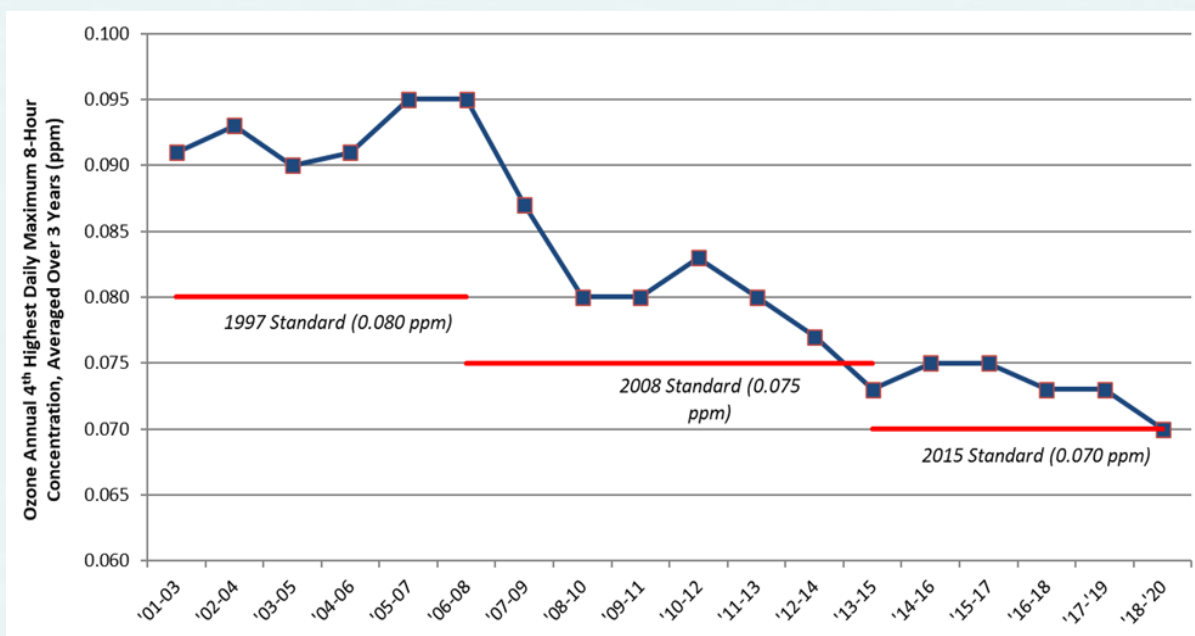
Figure 27. Ozone design values for Atlanta-Sandy Springs-Roswell MSA

[5] https://www.epa.gov/ozone-pollution/2015-revision-2008-ozone-national-ambient-air-quality-standards-naaqs-supporting

8-hour ozone exceedances in Atlanta-Sandy Springs-Roswell MSA

In 2020, the Atlanta-Sandy Springs-Roswell MSA area had only one day that exceeded the current (0.070 ppm) 8-hour standard. In 2019 there were 18 days, and in 2018 there were 10 days.

The term 'exceedance' is defined as a daily maximum 8-hour average greater than the standard. The Atlanta-Sandy Springs-Roswell MSA ozone monitors and the number of exceedances over the 8-hour ozone standard (0.070 ppm) in 2018, 2019, and 2020 are mapped in Figure 28.

Figure 28. Map of 2018-2020 Atlanta MSA Ozone Exceedances
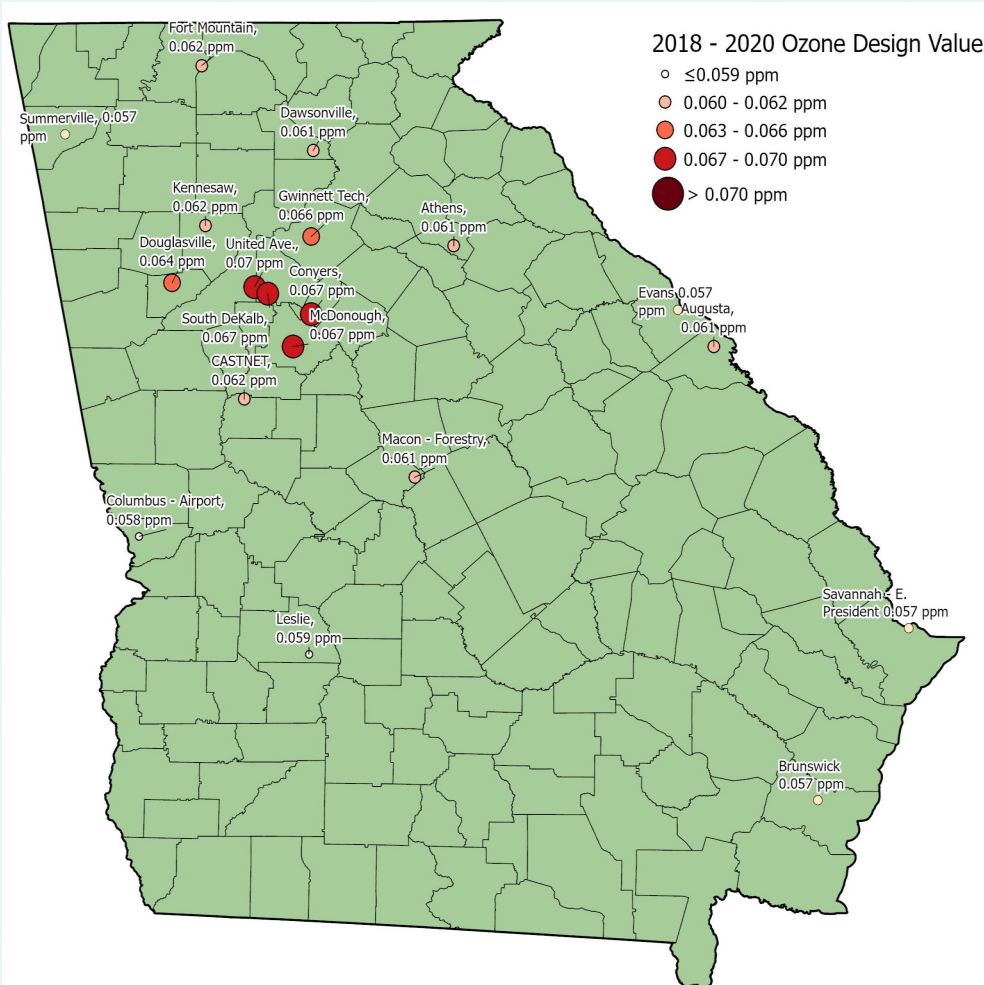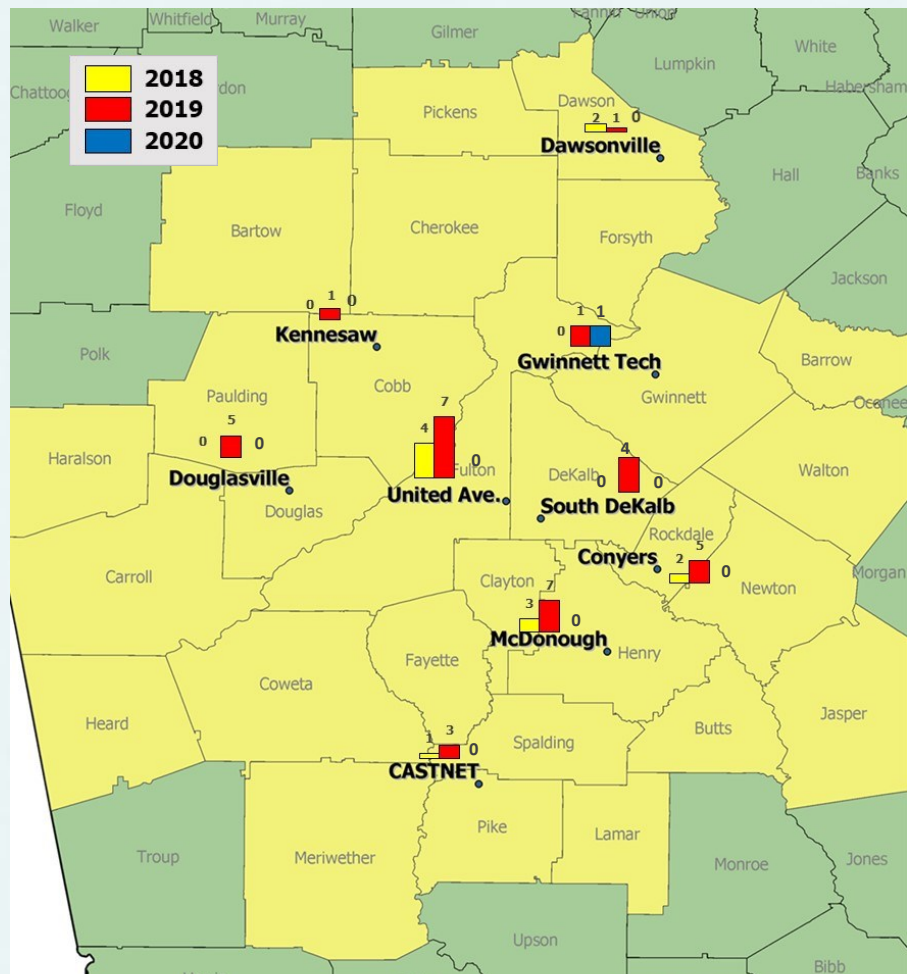
Statewide 8-hour ozone concentrations

Figure 29 shows the three-year average of ozone values across the state. The larger and darker circles indicate higher values. In 2020, the design values across the state were 0.070 ppm or less in each of the areas where ozone is monitored, meeting the 2015 Ozone NAAQS (as well as the previous levels of the NAAQS).

Figure 29. 2018-2020 Statewide Ozone Design Values

Lead (Pb)

What is it?

Lead is a naturally occurring element found in small amounts in the earth's crust. While it has some beneficial uses, it can be toxic to humans and animals causing detrimental health effects. Learn more: https://www.epa.gov/lead

Where does it come from?

- In the past, the Clean Air Act required extensive lead monitoring to detect the high levels of airborne lead that resulted from the use of leaded gasoline. With the phase-out of leaded gasoline, lead concentrations decreased drastically by the late 1980s. Figure 30 shows the drop in annual averages from 1990 through 2020.

- A major source of lead is acid battery plants. Lead can also come from the dust of vehicle traffic, construction activities, and agricultural activities and deposit on leaves and plants. Aviation fuel used by small aircraft contains lead.

75%   **23%**   **2%**

See page 23 for icon key.
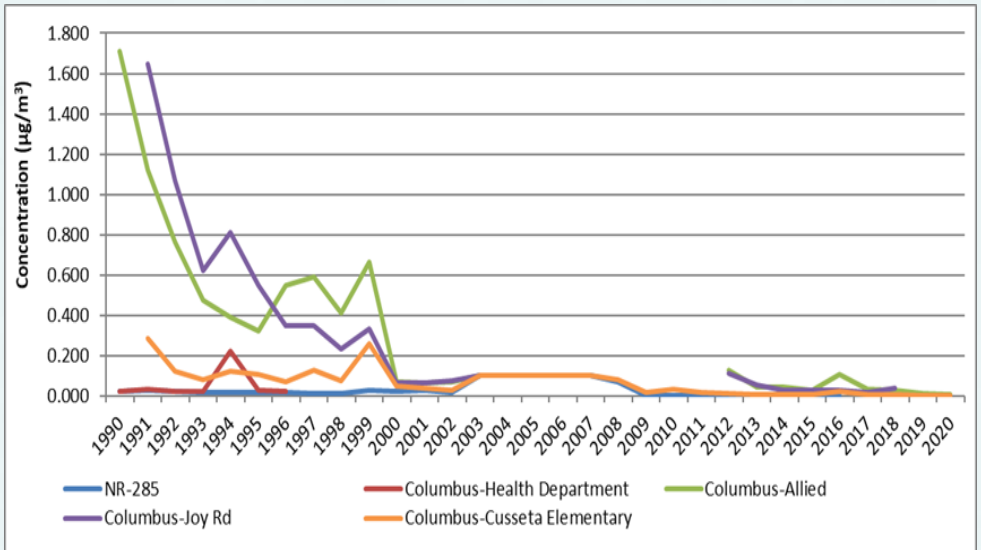
Figure 30. Georgia's Annual Lead Averages

Health Impacts

- Exposure mainly through inhalation and ingestion of lead in food, water, soil, or dust.
- Puts children at particular risk exposure since they commonly put hands, toys, and other items in their mouths, which may come in contact with lead-containing dust and dirt.
- Bioaccumulates in blood, bones, and tissues.
- Can damage kidneys, liver, and nervous system.
- Excessive and repeated exposure leads to neurological impairments that can cause seizures, mental retardation, and behavioral disorders especially in children, infants, and fetuses.
- Lead toxicity is rarely attributed to a single exposure or digestive event, it is the product of chronic exposure over time.
- May be a factor in high blood pressure and subsequent heart disease.
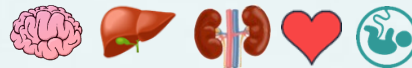
Georgia Monitoring Information for Lead

Muscogee

Columbus - Allied
Columbus - Cusseta

Measurement Technique

24-hour total suspended particulate (100 microns or less) on 8"x10" pre-weighed fiberglass filter[6]

MORE INFORMATION ABOUT MEASUREMENT TECHNIQUE

[6] https://tisch-env.com/high-volume-air-samplers/

Figure 31. Georgia's lead monitoring sites

National Ambient Air Quality Standards for Lead

Primary NAAQS: Rolling 3-month average, not to exceed 0.15 ug/m^3

Secondary NAAQS: Same as the Primary Standards

Attainment Designation

- Figure 32 shows how Georgia's lead data compares to the rolling three-month average standard for 2012 through 2020.

- The last of the three months used for each average is indicated on the graph.

- The monitors in the Columbus GA-AL MSA are located near a lead battery manufacturer, and in November 2016, there was a violation of the lead standard in Columbus due to a malfunction on a silo control and is reflected in the graph below. The manufacturing plant ceased all operations in 2019.
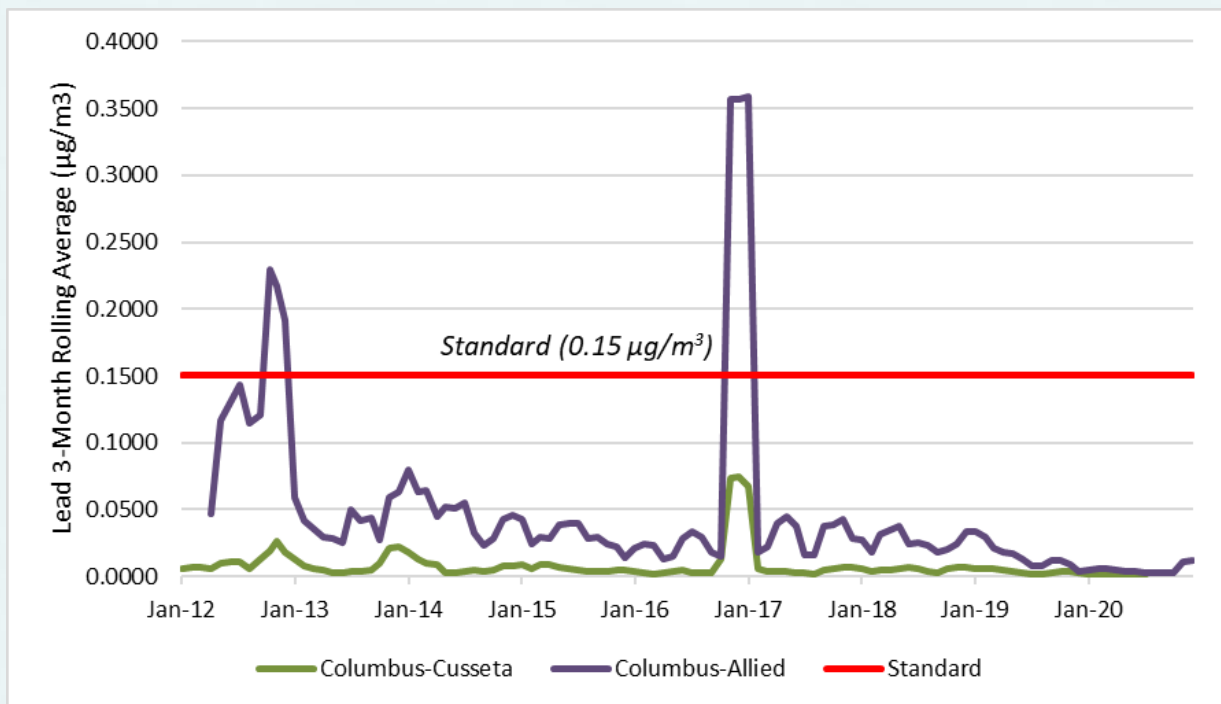
Figure 32. Georgia's three-month rolling averages, 2012-2020

Particulate Matter PM$_{10}$ and PM$_{2.5}$

Learn more: https://www.epa.gov/pm-pollution

- Particulate matter includes a broad range of material that consists of solid particles, fine liquid droplets, or condensed liquids absorbed onto solid particles.

- Airborne particulates are not a single pollutant as discussed for the other criteria pollutants, but rather a mixture of many different air pollutants.

- There are two ways that particulate matter is formed, known as primary and secondary.

- Primary sources that emit particles directly include combustion, incineration, construction, mining, metals smelting, metal processing, and grinding sources.

- Other primary sources include diesel engine exhaust, road dust, wind blown soil, forest fires, open burning of vegetation for land clearing or waste removal, ocean spray, and volcanic activity.

- A great deal of particulate matter is in form of gaseous air pollutants that readily react with oxygen and each other. While many of those reactions produce other gases, they frequently produce particles. Particles formed through this process are known as secondary particulate matter such as sulfate particles, nitrate particles, and calcium nitrate or sodium nitrate particulates.

- Alternative diesel fuels are available that emit less particulate matter, as well as other pollutants.

- Ultra-low sulfur diesel fuel is one fuel that emits less sulfur dioxide, a source of particulate matter formation.

- Biodiesel fuel emits less particulate matter, carbon monoxide, hydrocarbons, and air toxics.

- Also, emulsified diesel emits less nitrogen oxides and particulate matter.

- Particulate pollution may be categorized by size since there are different health impacts associated with the different sizes of particulate matter.

- We currently monitor for three sizes of particles: **PM$_{10}$** (up to 10 microns in diameter), **PM$_{2.5}$** (up to 2.5 microns in diameter) and **PM$_{coarse}$** (PM$_{10}$ minus PM$_{2.5}$). To illustrate the size differences, Figure 33 shows how approximately ten PM$_{10}$ particles can fit on a cross section of a human hair, and approximately thirty PM$_{2.5}$ particles would fit on a cross section of a hair.

- These particles and droplets are invisible to the naked eye, and composition and sources can vary greatly by region.

- Regional relative humidity can affect the level of water present within the particles and affect how much dissolved gases or reactive species enter the lungs when particles are inhaled.
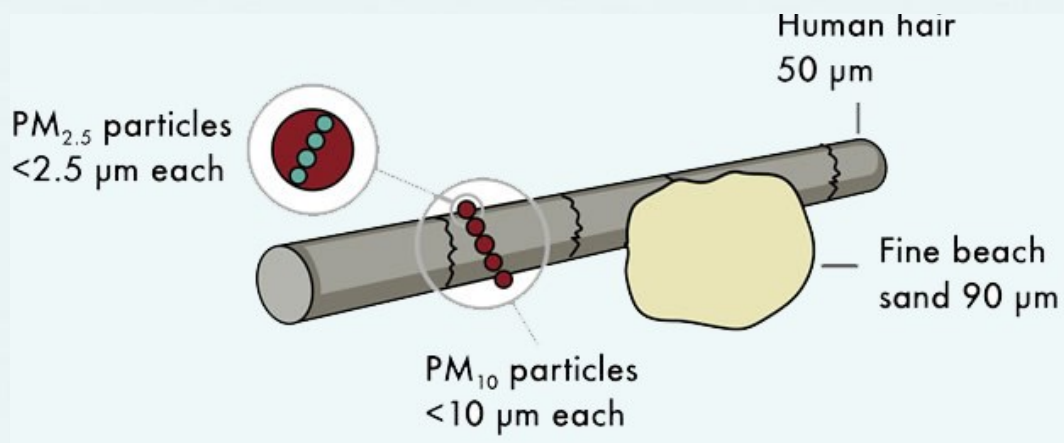
Figure 33. Comparison of particulate matter size to human hair

PM$_{10}$

What is it?

PM$_{10}$ are dust particles that are up to 10 micrometers in diameter.

Where does it come from?

Sources include crushing or grinding operations and dust stirred up by vehicles on roads.

| 75% | 12% | 5% | 2% | 3% | 2% | 1% |

See page 23 for icon key.

Health Impacts

- Penetrate deeply into the lungs.

- Breathing and respiratory problems, aggravation of existing respiratory and cardiovascular disease, alterations in the body's defense system against inhaled materials and organisms, and damage to lung tissue.

- Individuals with chronic lung or cardiovascular disease, individuals with influenza, asthmatics, elderly people, and children are most effected.

Georgia Monitoring Information for PM$_{10}$
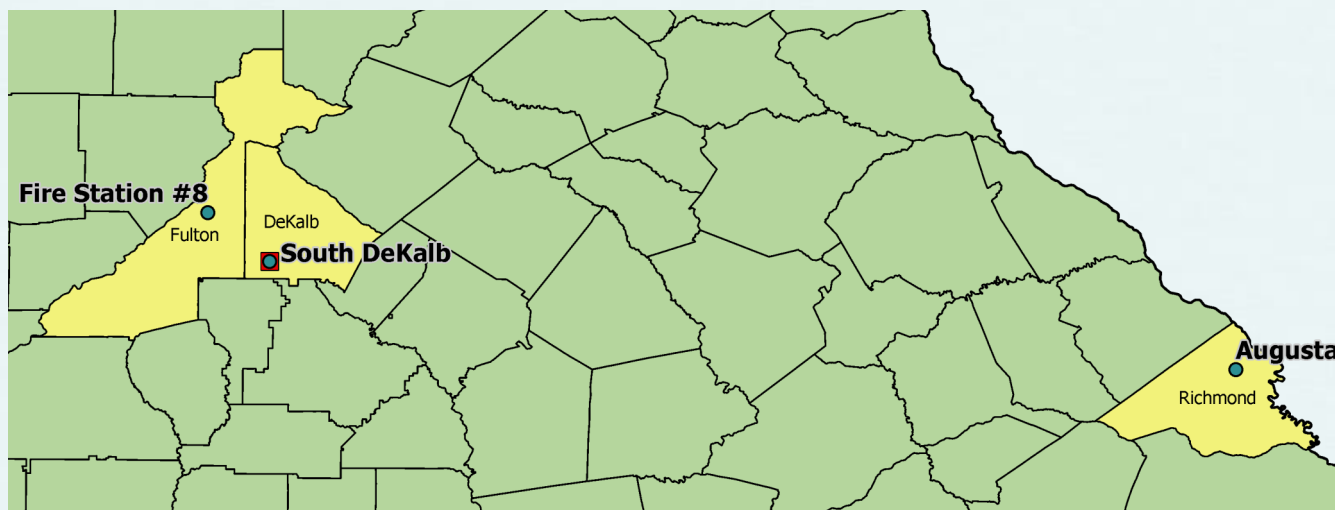
Figure 34. Georgia's PM$_{10}$ and PM$_{coarse}$ (red square) monitoring sites

Measurement Techniques

- Two categories of EPA-approved reference or equivalent monitors are used to determine attainment with the PM$_{10}$ standard (integrated and continuous):

⇒ Integrated low-volume monitor that collects a 24-hour sample through an impaction inlet device that only allows particles with 10 microns or less in size to reach the filter media.[7]

⇒ Continuous Teledyne T640X monitor and tapered element oscillating microbalance (TEOM) method with an inlet designed to cut out particles larger than 10 microns in size.[8,9]

MORE INFORMATION ABOUT MEASUREMENT TECHNIQUES

[7] https://tisch-env.com/low-volume-air-sampler/
[8] http://www.teledyne-api.com/products/particulate-instruments/t640
[9] https://www.thermofisher.com/order/catalog/product/1400AB

National Ambient Air Quality Standards for Particulate Matter PM$_{10}$

Primary NAAQS: **Number of days with a maximum of 24-hour concentration of 150 μg/m^3 must not exceed more than once per year on average over 3 years**

Secondary NAAQS: **Same as the Primary Standards**

Attainment Designation

- Figure 35 shows how Georgia compares to the 24-hour standard for PM$_{10}$, which is 150 μg/m^3.

- The standard allows one exceedance per year, averaged over a 3-year period; therefore, this chart shows the second highest 24-hour average for each site. All three samplers collected data well below the standard.
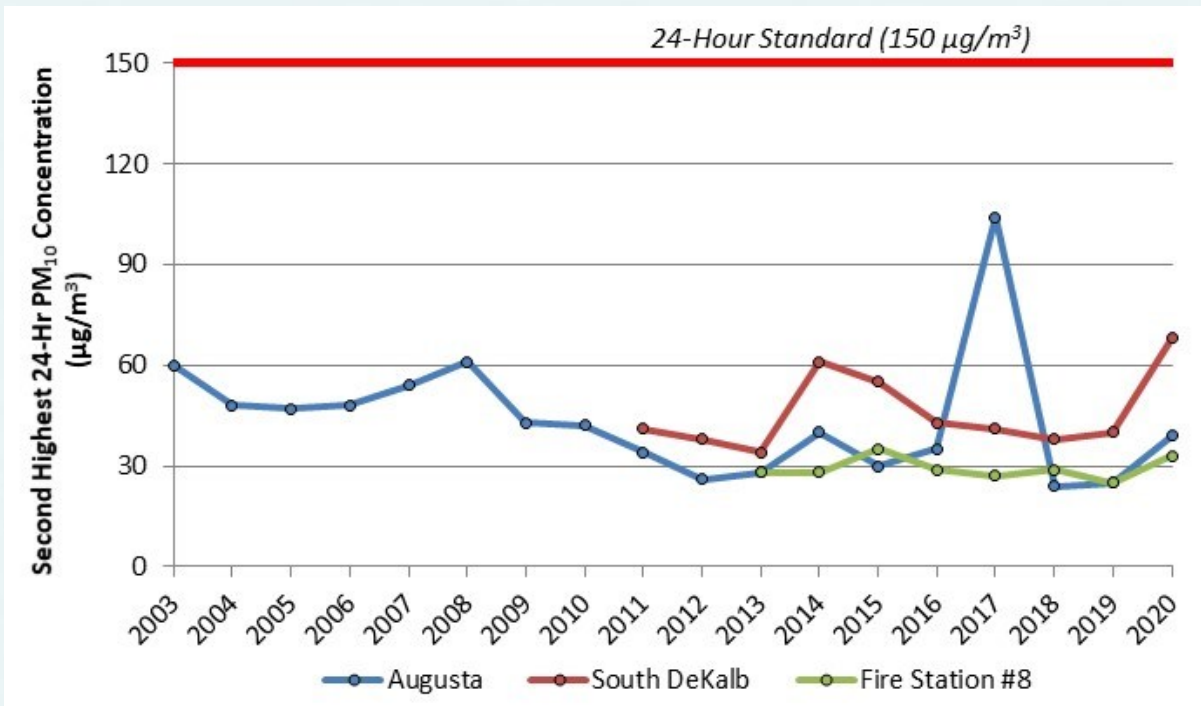
Note: A house fire near the Augusta site caused values to be higher than normal in 2017. In addition, the sampler at this site began collecting hourly data in 2018.

Figure 35. PM$_{10}$ annual second maximum 24-hour concentrations

PM$_{2.5}$

What is it?

- PM$_{2.5}$ are particles that are 2.5 micrometers in diameter or smaller, and can only be seen with an electron microscope. Most particles form in the atmosphere as a result of complex reactions of chemicals such as sulfur dioxide and nitrogen oxides.

Where does it come from?

- Fine particles are produced from dust and all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.

| 57% | 22% | 7% | 6% | 2% | 2% | 4% |
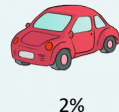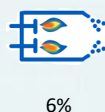
See page 23 for icon key.

Health Impacts

- Can penetrate deep into lung tissue and even enter the bloodstream. This may cause significant respiratory or cardiovascular problems that can shorten an individual's lifespan.

- High risk groups include children, the elderly, and people with cardiovascular or lung diseases such as emphysema and asthma.

Georgia Monitoring Information for PM$_{2.5}$

Measurement Techniques

- Two types of methods: integrated and continuous.

- The integrated samplers are the official reference method (FRM) used for determining which areas in Georgia are attainment (meeting the national standard). Integrated samplers collect samples on Teflon filters for 24 hours, using a 2.5 microns particle size sorting device.[10]

- The continuous method consists of four types of instruments.

  ⇒ The beta attenuation method (BAM) is designed for the inlet to cut out particles larger than 2.5 microns in size. As of March 2019, the one site (Albany) where EPD had a BAM[11] sampler running as an Federal Equivalent Method (FEM) sampler was replaced with a Teledyne T640 (see below) which can be used for attainment determinations as well .

  ⇒ The Teledyne T640/T640X is an optical aerosol spectrometer that converts optical measurements to mass measurements by determining sampled particle size via scattered light using 90° white-light scattering with polychromatic LED.[12] These samplers are also FEMs and collect data that can be used for attainment determinations.

  ⇒ The tapered element oscillating microbalance (TEOM) method is used to support the development of air quality models and forecasts, including the Air Quality Index (AQI), and provide the public with information about pollutant concentrations in real time. As set up at EPD's sites, these samplers cannot be used for making attainment determinations.[13]

  ⇒ The nephelometer determines PM concentrations by measuring the shutter count which allows the light source to stabilize, and wavelengths which shows the average diameter of the measured particle size.[14] These samplers cannot be used for attainment determinations.

- Continuous PM$_{2.5}$ data is reported every hour on Georgia's Ambient Air Monitoring web page located at https://airgeorgia.org/. The immediate availability of this data allows the public to make informed decisions regarding their outdoor activities.

MORE INFORMATION ABOUT MEASUREMENT TECHNIQUES

[10] https://www.thermofisher.com/order/catalog/product/2025I

[11] http://www.metone.com/products/air-quality-monitors/

[12] http://www.teledyne-api.com/products/particulate-instruments/t640

[13] https://www.thermofisher.com/order/catalog/

[14] https://www.ambilabs.com/nephelometer

Figure 36 shows the location of Georgia's PM$_{2.5}$ FRM monitors and Figure 37 shows the location of PM$_{2.5}$ continuous and speciation monitors.

Figure 36. Georgia's PM$_{2.5}$ FRM monitoring sites
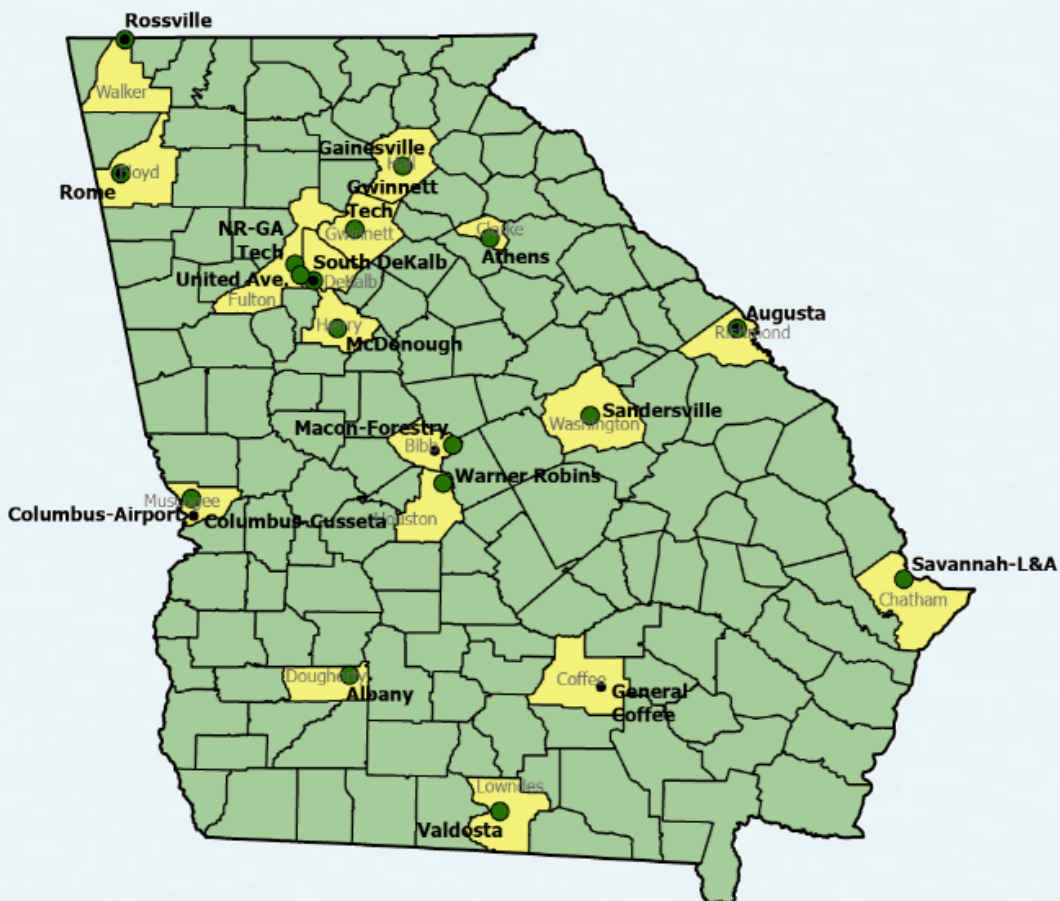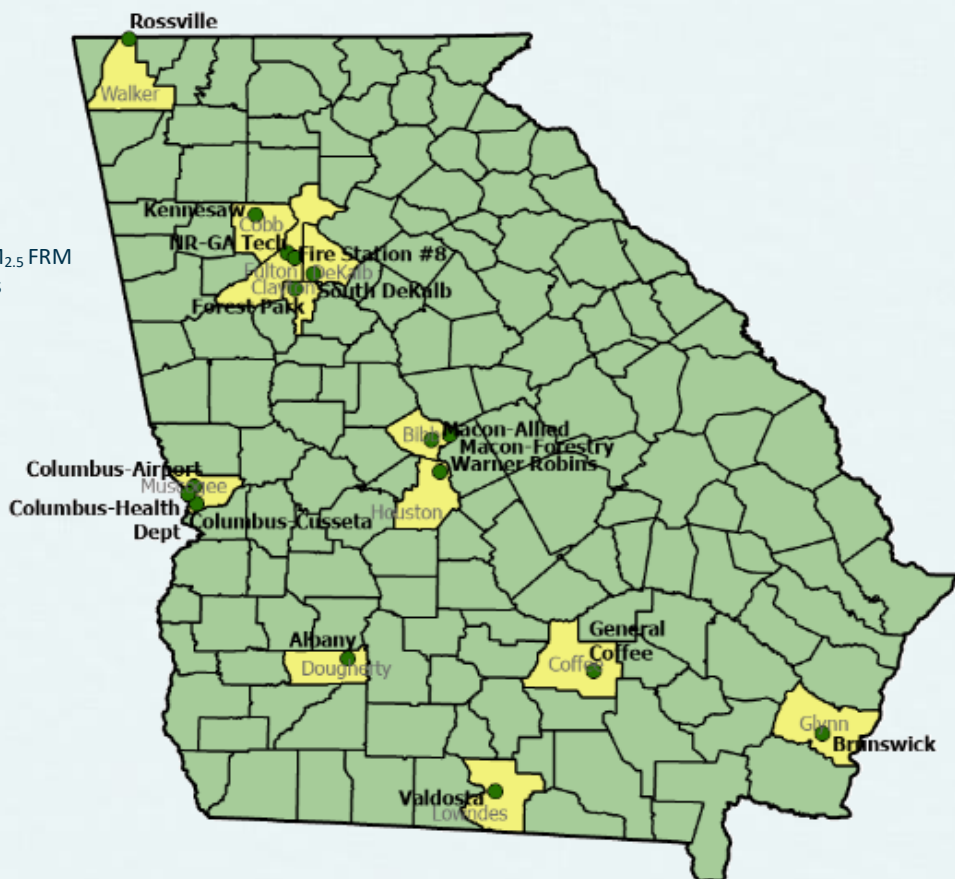
Figure 37. Georgia's PM$_{2.5}$ continuous (green circles) and PM$_{2.5}$ speciation (black dots) monitoring sites

Saharan Dust Event

PM$_{2.5}$ exceedances on June 26 and 27 across the state were primarily the result an unusually strong, Saharan dust plume streaming over the North Atlantic Ocean and impacting the Southeastern U.S. NASA/NOAA Suomi NPP satellite imagery on June 24th showed the leading edge of the Saharan dust plume that impacted the state. Elevated dust aerosol optical thickness was evident in NASA GEOS dust analysis on the 27th as well. Meteorological conditions were conducive for the accumulation of dust particles in the atmosphere during the period, as a strong surface high pressure system settled over the southeast. This contributed to the elevated Air Quality Index (AQI) readings shown in Table 1 on page 52. Atmospheric sounding data from Peachtree City, Georgia showed a strong surface inversion, which limited vertical mixing and aided in trapping dust particles near the surface. Surface winds remained relatively light through the period, predominantly from the WNW to WSW.

These Saharan Aerosol Dust events typically occur over the Atlantic Ocean from dust plumes that originate from Africa's west coast followed by tropospheric transport across the Atlantic and the Caribbean Sea and eventually making it to the Gulf of Mexico. This dust plume was wrapped around a large anticyclone whose center was positioned over the Florida Peninsula, and then transported across the Southeastern U.S. and was even visible from the Great Smokey Mountains in Tennessee. Saharan Dust is composed primarily of crustal aerosol (mainly silicon, iron, and clays) although minor components of carbonaceous material can be found. It is considered to be a health hazard (mainly respiratory), but it can also cause visibility degradation, while creating vibrant sunsets.
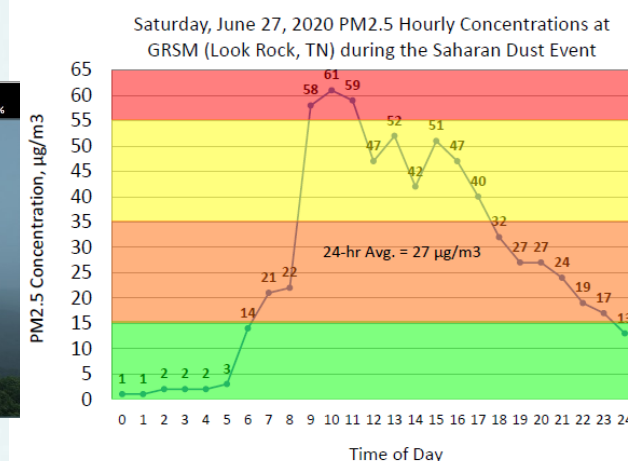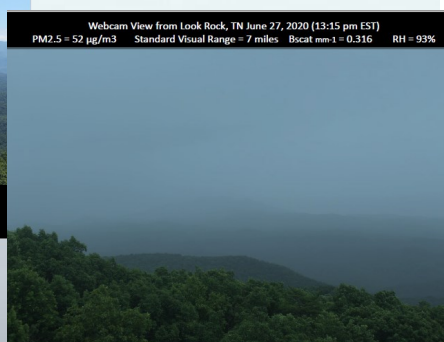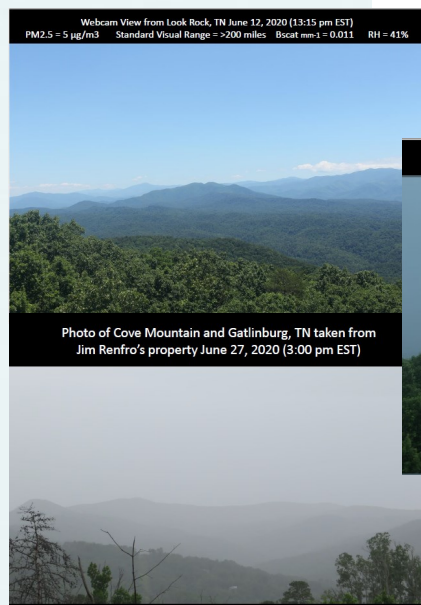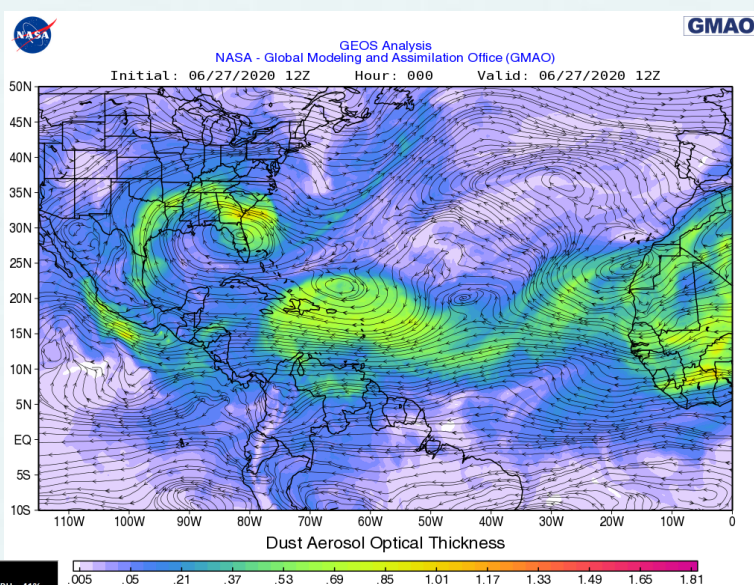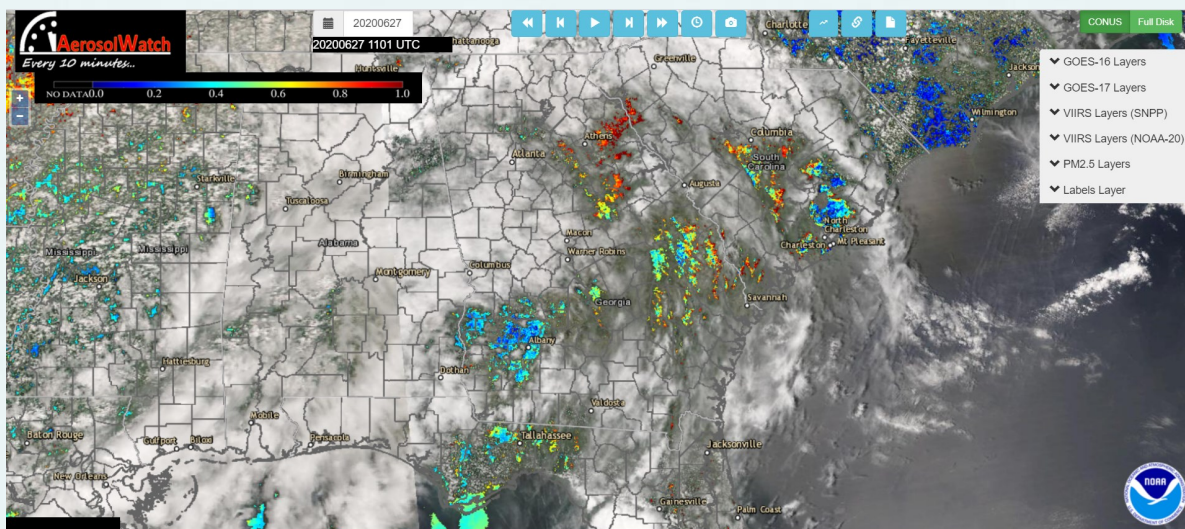
Figure 38. Saharan Dust June 26-27, 2020

Primary NAAQS: 3-year average of the annual weighted mean not to exceed 12.0 µg/m³

3-year average of the 98th percentile of 24-hour concentration not to exceed 35 µg/m³

Secondary NAAQS: 3-year average of the annual weighted mean not to exceed 15.0 µg/m³

3-year average of the 98th percentile of 24-hour concentration not to exceed 35 µg/m³

Attainment Designation

- For an area to be in attainment of the annual ambient air PM$_{2.5}$ standard, the three-year average of the annual average concentrations has to be less than or equal to 12.0 µg/m³.

- In addition, the 24-hour primary and secondary standard requires that the three-year average of the 98th percentile of the 24-hour concentrations be less than or equal to 35 micrograms per cubic meter.

- Currently all areas of Georgia are designated unclassifiable/attainment for the 2012 annual PM$_{2.5}$ standard because they are meeting the national standard.

PM$_{2.5}$ (µg/m³)
3-Year Averages of 98th Percentile of 24-Hour Averages for Each Metropolitan Statistical Area (MSA)
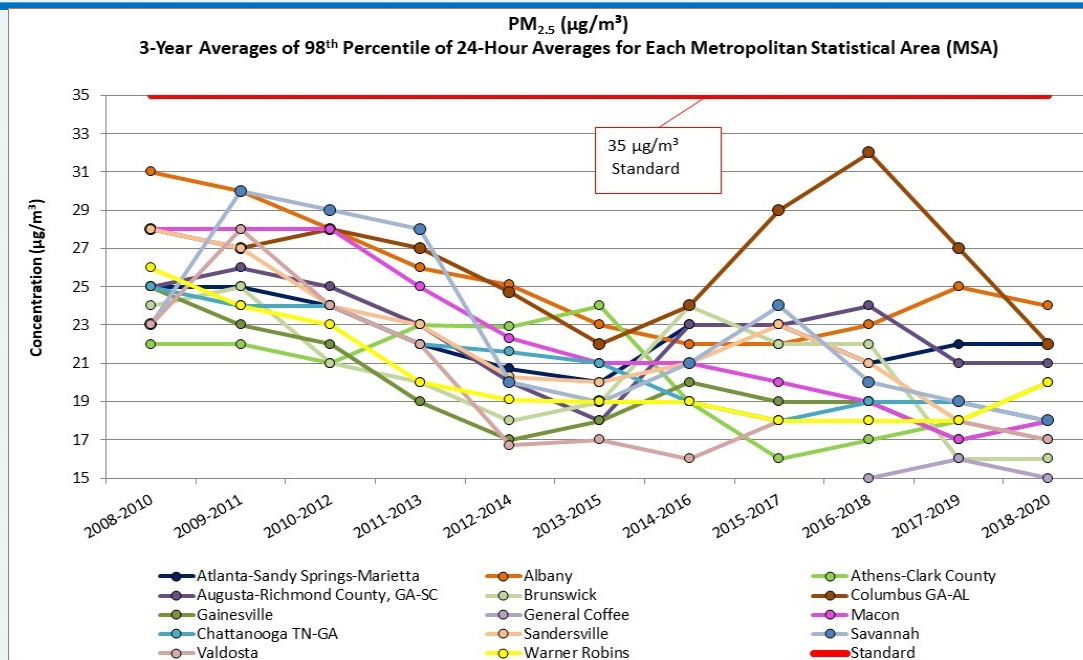
Figure 39. Comparison of the three-year averages of the 98th percentile of PM$_{2.5}$ 24-hour data

Note: Wildfires and prescribed fires in the Columbus, GA-AL MSA caused values to be higher than normally observed in this area.

PM$_{2.5}$ (µg/m³)
3-Year Averages of Highest Annual Averages for Each Metropolitan (MSA)
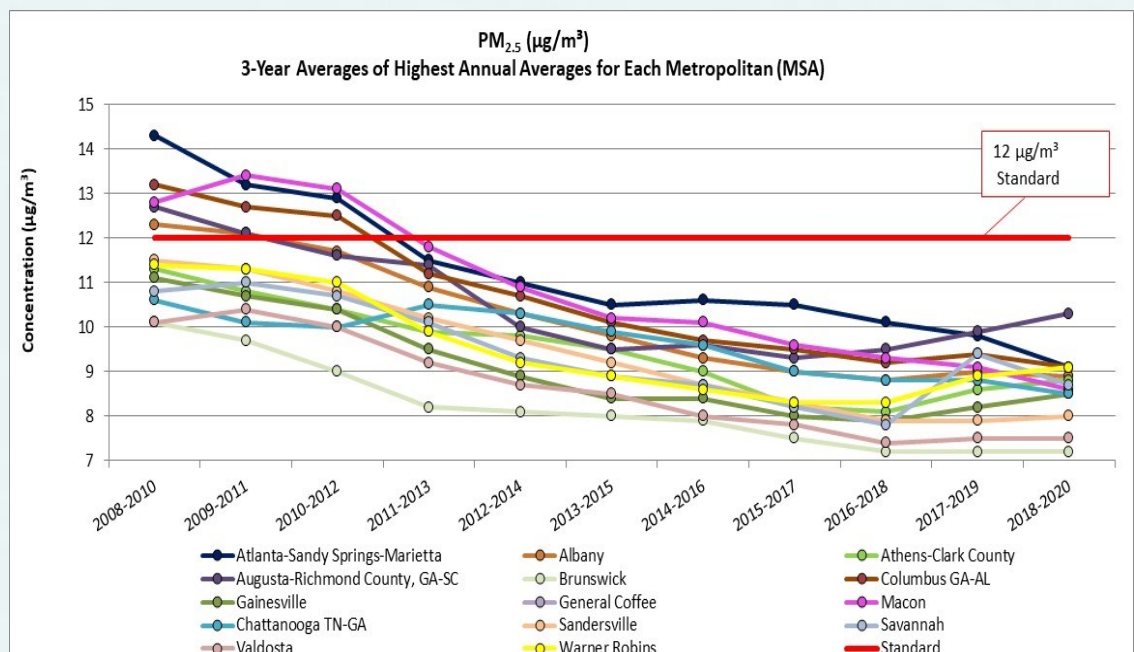
Figure 40. Comparison of the PM$_{2.5}$ three-year annual averages to the annual standard

PM₂.₅ Speciation

Particle speciation measurements are performed to support the regulatory, analytical, and public health purposes of the program. These measurements help scientists and regulators track the progress and effectiveness of newly implemented pollution controls. The data also improves scientific understanding of the relationship between particle composition, visibility impairment, and adverse human health effects.

Each individual particle, regardless of its source, has a distinct chemical composition which depends on local sources and a variety of other factors. Each has varying health effects based on its size and chemical composition.

Georgia currently monitors fifty-three species in particulate matter. Of these, sulfate and organic carbon are detected in the highest concentrations, with magnitudes of up to five to nine times greater than the other major species.

Refer to Figure 37 for a map of Georgia's PM₂.₅ Speciation monitors.

Figure 41 compares the percent composition of PM₂.₅ for each site based on 2019 annual averages.

- Organic carbon makes up 43-51% of PM₂.₅ for all sites with Macon having the largest percentage.

- Sulfate is the second largest portion of PM₂.₅ for all sites and ranges from 14-17%.

- Nitrate, crustal, elemental carbon, and ammonium ion each generally make up no more than about 3-17% of PM₂.₅ for all sites.

- The chemical elements typical of the Earth's crust are grouped together as "crustal".
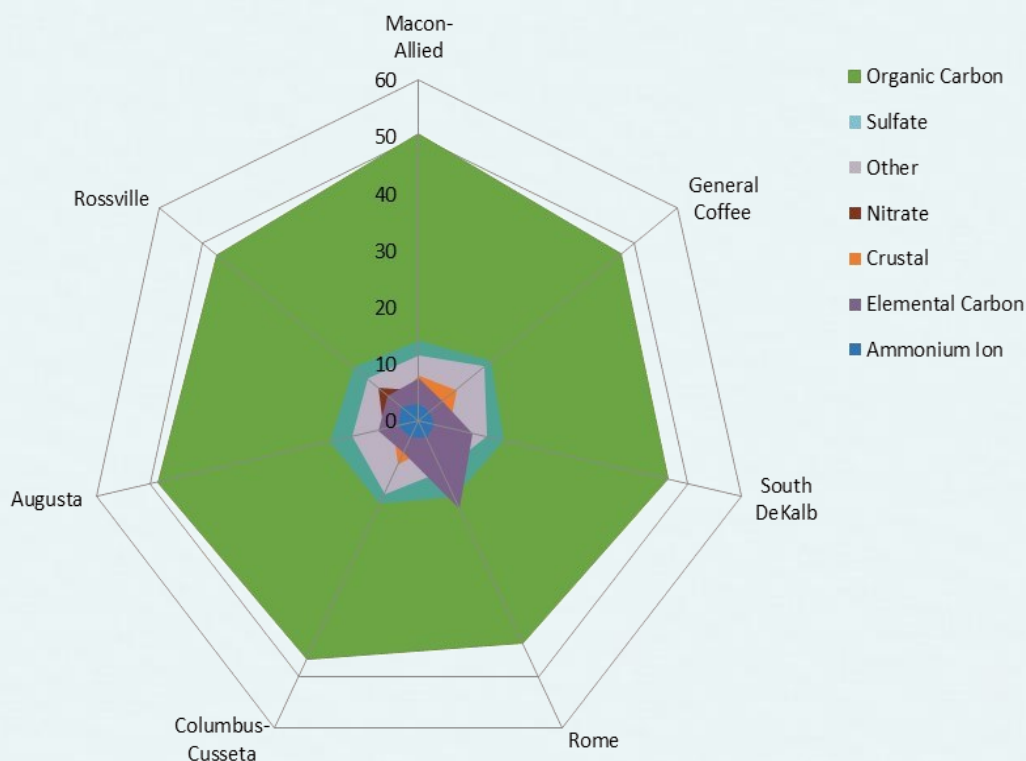
Figure 41. Percentages of 2020 Speciation Data

Measurement Techniques[15,16]

- Filter media with laboratory techniques using gravimetric (microweighing) analysis

- X-ray fluorescence and particle-induced X-ray emission for trace elements; Ion chromatography for anions and selected cations

- Controlled combustion for carbon

- Gas chromatography/mass spectroscopy (GC/MS) for semi-volatile organic particles

MORE INFORMATION ABOUT MEASUREMENT TECHNIQUES

[15] http://www.urgcorp.com/index.php/systems/manual-sampling-systems/urg-3000n-carbon-sampler

[16] http://www.metone.com/?wpfb_dl=228

PREDOMINANT SPECIES FOUND IN PM$_{2.5}$

Figure 42 presents each site with all species making up the composition at each location.

Ammonium Ion

Sulfate Products

Nitrate Products

Crustal Products

Elemental Carbon

Organic Carbon

Other
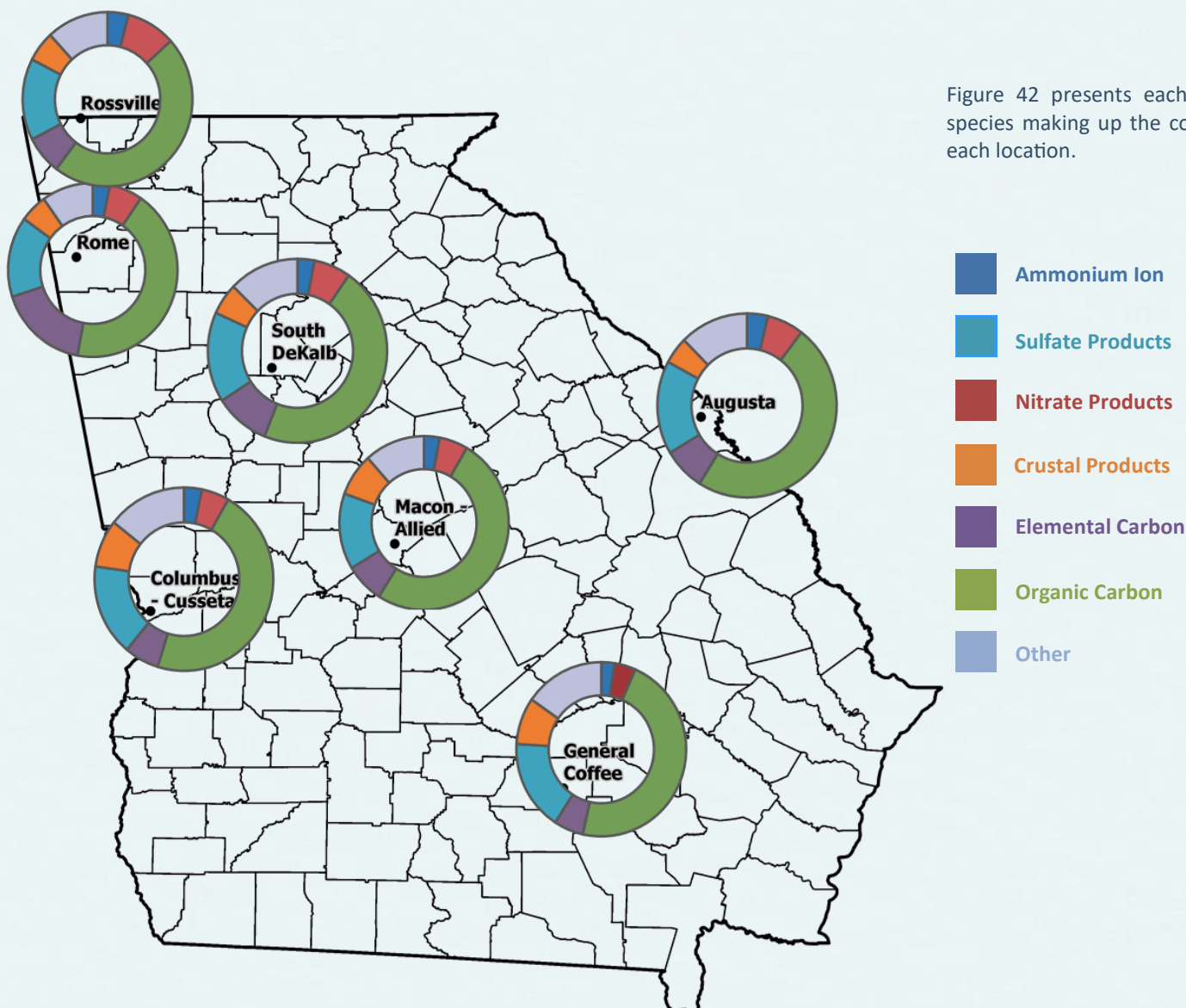
Figure 42. Annual averages of PM$_{2.5}$ composition data in Georgia

Ammonium Ion: commonly released by fertilizer production, livestock production, coke production, and some large refrigeration systems. Ironically, it can be emitted by NO$_x$ control systems installed on large fossil fuel combustion systems, which use ammonia or urea as a reactant.

Sulfate Products: formed during the oxidation of SO$_2$ in the atmosphere.

Nitrate Products: formed through a complex series of reactions that convert NO$_x$ to nitrates - vehicle emissions and fossil fuel burning.

Crustal Products: components that are the result from the weathering of Earth's crust—ocean salt and volcanic discharges— aluminum, calcium, iron, titanium, and silicon—released by metals production, and can be resuspended in the atmosphere by mechanisms that stir up fine dust, such as mining, agricultural processes, and vehicle traffic.

Elemental Carbon: carbon in the form of soot- diesel engine emissions, wood-burning fireplaces, and forest fires.

Organic Carbon: may be released directly, but are also formed through a series of chemical reactions in the air, mostly as a result of the burning of fossil fuels and wood.

The Air Quality Index

The Air Quality Index (AQI) is a national air standard rating system developed by the U.S. Environmental Protection Agency. The AQI is used statewide to provide the public, on a daily basis, with an analysis of air pollution levels and possible related health risks.

Generally, an index scale of 0 to 500 is used to assess the quality of air, and these numbers are synchronized with a corresponding descriptor word such as: Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy, and Very Unhealthy. To protect public health the EPA has set an AQI value of 100 to correspond to the NAAQS for the following criteria pollutants: Ozone (O_3), Sulfur Dioxide (SO_2), Carbon Monoxide (CO), Particulate Matter 10 (PM_{10}), Particulate Matter 2.5 ($PM_{2.5}$), and Nitrogen Dioxide (NO_2).

The AQI for a reporting region equates to the highest rating recorded for any pollutant within that region. Therefore, the larger the AQI value, the greater level of air pollution present, and the greater expectation of potential health concerns. However, this system only addresses air pollution in terms of acute health effects over time periods of 24 hours or less and does not provide an indication of chronic pollution exposure over months or years. Figure 43 shows how the recorded concentrations correspond to the AQI values, descriptors and health advisories. Each day the AQI values are available to the public through Georgia EPD's Ambient Air Monitoring website at https://airgeorgia.org/.

Maximum Pollutant Concentration									
$PM_{2.5}$ (24hr) µg/m³	PM_{10} (24hr) µg/m³	SO_2 (1hr)* ppm	O_3 (8hr)^ ppm	O_3 (1hr) ppm	CO (8hr) ppm	NO_2 (1hr) ppm	AQI Value	Descriptor	EPA Health Advisory
0.0–12.0	0–54	0–0.035	0.000–0.054	None	0.0–4.4	0–0.053	0 to 50	Good (green)	Air quality is considered satisfactory, and air pollution poses little or no risk.
12.1–35.4	55–154	0.036–0.075	0.055–0.070	None	4.5–9.4	0.054-0.100	51 to 100	Moderate (yellow)	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people. For example, people who are unusually sensitive to the condition of the air may experience respiratory symptoms.
35.5–55.4	155–254	0.076–0.185	0.071–0.085	0.125–0.164	9.5–12.4	0.101-0.360	101 to 150	Unhealthy for Sensitive Groups	Members of sensitive groups (people with lung or heart disease) are at greater risk from exposure to particle pollution. Those with lung disease are at risk from exposure to ozone. The general public is not likely to be affected in this range.
55.5–150.4	255–354	0.186–0.304*	0.086–0.105	0.165–0.204	12.5–15.4	0.361-0.649	151 to 200	Unhealthy (red)	Everyone may begin to experience health effects in this range. Members of sensitive groups may experience more serious health effects.
150.5–250.4	355–424	0.305–0.604*	0.106–0.2	0.205–0.404	15.5–30.4	0.650–1.249	201 to 300	Very Unhealthy (purple)	AQI values in this range trigger a health alert. Everyone may experience more serious health effects. When the AQI is in this range because of ozone, most people should restrict their outdoor exertion to morning or late evening hours to avoid high ozone exposures.
250.5–350.4	425–504	0.605–0.804*	None^	0.405–0.504	30.5–40.4	1.250–1.649	301 to 400	Hazardous (maroon)	AQI values over 300 trigger health warnings of emergency conditions. The entire population is more likely to be
350.5–500	505–604	0.805–1.004*	None^	0.505–0.604	40.5–50.4	1.650–2.049	401 to 500		

Figure 43. The AQI, *AQI values of 200 or greater are calculated with 24-hr SO_2 concentrations, ^AQI values of 301 or greater are calculated with 1-hr O_3 concentrations. **AQI numbers above 100 may not be equivalent to a violation of the standard

2020 AQI Values Summary for Georgia

Air Quality Index Summary by CBSA						
Number of Days						
Pollutants Monitored in 2019	**Good (0-50)**	**Moderate (51-100)**	**Unhealthy for Sensitive Groups (101-150)****	**Unhealthy (151-200)****	**Very Unheathy (201-300)****	**Hazardous (>300)****
Albany						
PM$_{2.5}$	276	87	-	-	-	-
Americus						
O$_3$	237	3	-	-	-	-
Athens-Clark County						
O$_3$, PM$_{2.5}$	312	54	-	-	-	-
Atlanta-Sandy Springs-Roswell						
O$_3$, NO$_2$, PM$_{2.5}$, CO, SO$_2$, PM$_{10}$	241	122	3	-	-	-
Augusta-Richmond County, GA-SC						
O$_3$, PM$_{2.5}$, PM$_{10}$	264	98	4	-	-	-
Brunswick						
O$_3$, PM$_{2.5}$	273	12	-	-	-	-
Chattanooga, TN-GA						
O$_3$, PM$_{2.5}$	151	26	-	-	-	-
Columbus, GA-AL						
O$_3$, PM$_{2.5}$	317	48	1	-	-	-
Dalton						
O$_3$	243	13	-	-	-	-
General Coffee						
PM$_{2.5}$	115	4	1	-	-	-
Gainesville						
PM$_{2.5}$	304	55	-	-	-	-
Macon						
O$_3$, SO$_2$, PM$_{2.5}$	284	81	1	-	-	-
Rome						
SO$_2$, PM$_{2.5}$	322	43	-	-	-	-
Savannah						
O$_3$, SO$_2$, PM$_{2.5}$	296	68	2	-	-	-
Summerville						
O$_3$	244	1	-	-	-	-
Valdosta						
PM$_{2.5}$	177	24	1	-	-	-
Warner Robins						
PM$_{2.5}$	287	74	1	-	-	-

Table 1. 2020 AQI summary data, most days had an AQI value in the 'Good' (0-50) category for all the sites.

Atlanta-Sandy Springs-Roswell MSA

Figure 44 shows in more detail the AQI values for the Atlanta-Sandy Springs-Roswell MSA. There were three days with an AQI value above 100 in 2020, down from 18 days in 2019. Ozone is a major driver of an elevated AQI and can be higher in the summer months due to increased sunlight. Higher ozone and $PM_{2.5}$ concentrations are the primary sources of AQI values in the "Unhealthy for Sensitive Groups" category in the Atlanta-Sandy Springs-Roswell MSA. Please refer to the Saharan Dust Event discussion on page 47 that details this dust event contributing to elevated $PM_{2.5}$ levels.
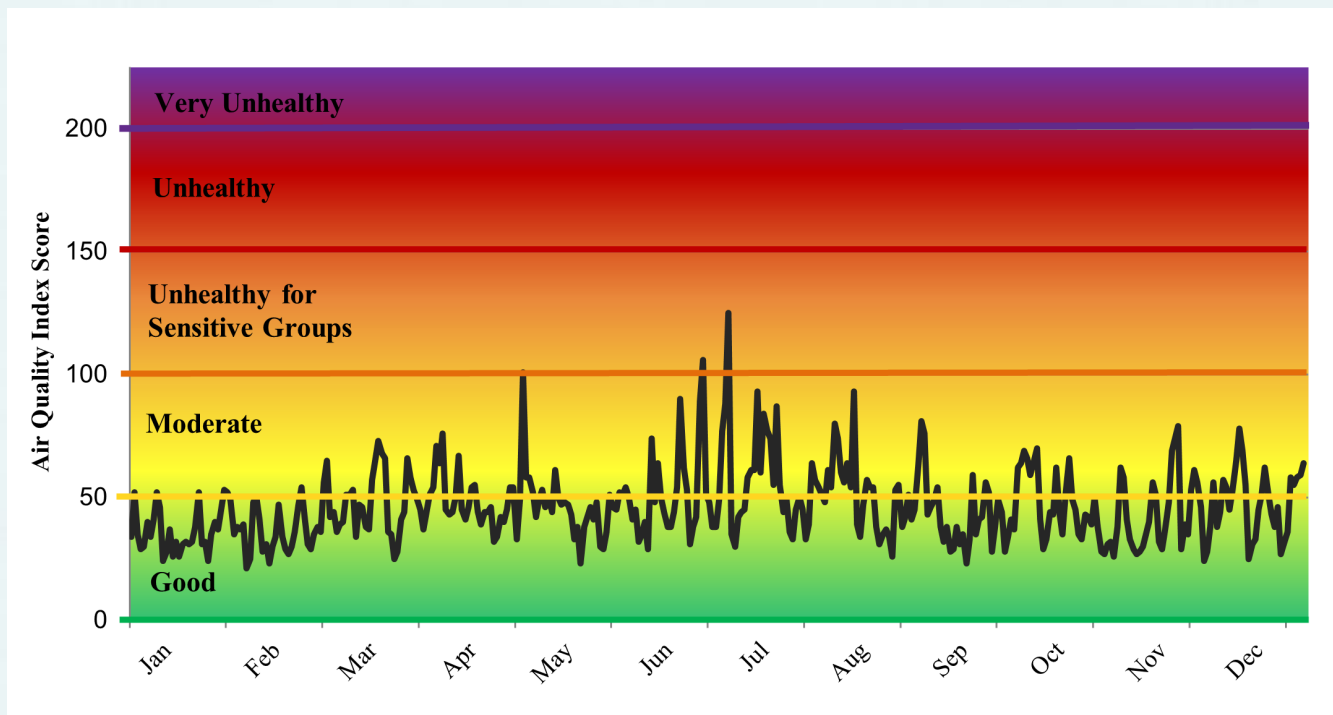
Figure 44. 2020 AQI Values for the Atlanta-Sandy Springs-Roswell MSA

PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

To better understand ozone formation, EPD monitors oxides of nitrogen, volatile organic compounds (VOCs), carbonyl compounds, and meteorological parameters at the PAMS site. For the 2020 PAMS season, no VOCs data was collected due to instrument issues at the site. The PAMS network requirements were modified with the promulgation of the 2015 Ozone NAAQS. The new requirements were required to be operational by June 1, 2021. The data shown below is based on historical data from the GA AAMP network.

Isoprene, the tracer for VOCs emissions from vegetation, is by far the largest contributor to ozone formation at the PAMS site. It is naturally released in large quantities by conifer trees, which are very abundant in the Southeastern United States.

Georgia Monitoring Information

Figure 45. Georgia's PAMS monitoring site

MORE INFORMATION ABOUT MEASUREMENT TECHNIQUE

17 https://www.agilent.com/en/product/gas-chromatography/gc-sample-preparation-introduction/thermal-desorption

Measurement Techniques

• From June through August, volatile organic compounds and hydrocarbon samples are analyzed hourly at the South DeKalb PAMS site using a gas chromatography unit with thermal desorption (TD).[17] However, this sampler was not operational for the 2020 season.

The amount of isoprene emissions from conifers varies seasonally, with emissions increasing as length of daylight and temperature increases (Figure 46).
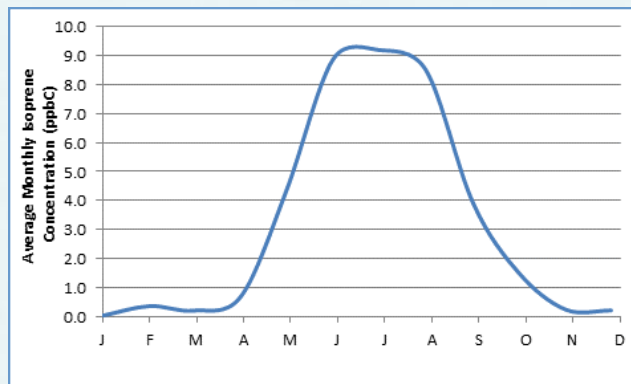
Figure 46. Average yearly profile of isoprene
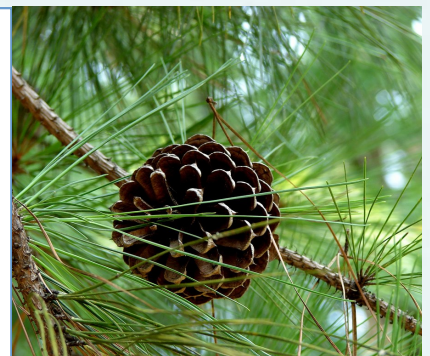
Toluene (generally the most abundant anthropogenic species in urban air) reaches the air from a variety of sources such as combustion of fossil fuels and evaporative emissions, motor vehicle fuel and is also used as a common solvent in many products such as paint. It is relatively constant throughout the year, suggesting a steady level of emissions year-round (Figure 47).
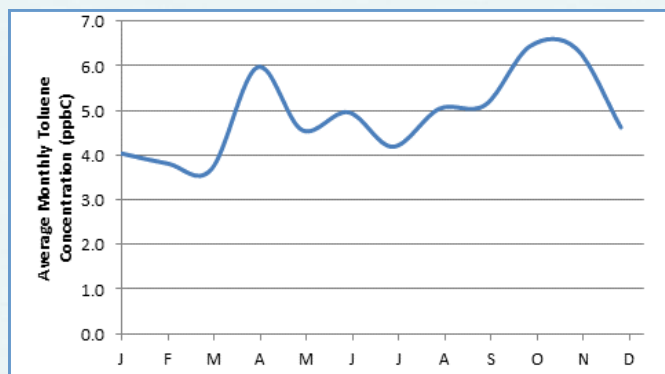
Figure 47. Toluene average annual occurrence

Carbonyl Compounds

Carbonyl compounds define a large group of organic compounds, which include acetaldehyde, acrolein, and formaldehyde. These compounds can lead to ozone formation.

Sources of carbonyl compounds include vehicle exhaust, cigarette smoke, paper production, stationary internal combustion engines and turbines, solvents, polymers, plastics, and the combustion of wood.

Depending on the amount inhaled, exposure to these compounds can cause irritation to the eyes, ears, nose, and throat, dizziness, and damage to the lungs.

Figure 48. Georgia's carbonyls monitoring site

Carbonyls Total Averages (ppb) for 2020

Benzaldehyde, 0.3
Formaldehyde, 1.3
Acetone, 1.9
Butyraldehyde, 0.5
Propionaldehyde, 0.2
Acetaldehyde, 0.9
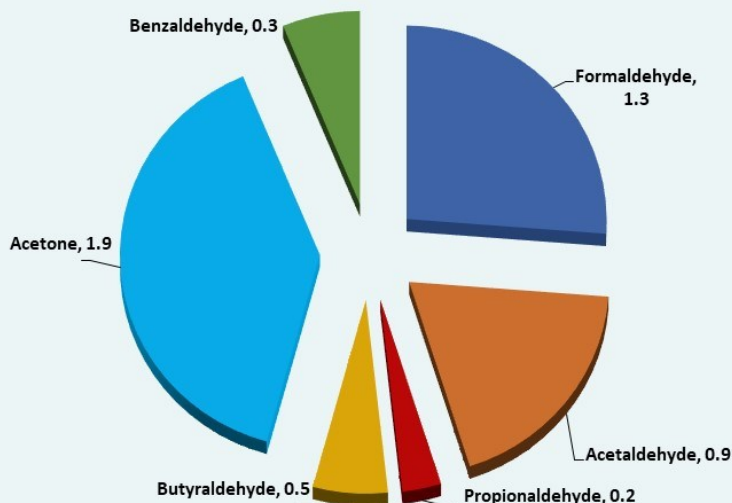
Figure 49. Total Average 24-hour carbonyl concentrations by species

Measurement Techniques

The carbonyls are sampled with two types of methods.

- One method includes an absorbent cartridge filled with dinitrophenylhydrazine (DNPH), using High Performance Liquid Chromatography analysis. [18]

- Another collection method is the canister sampler that is used for sampling volatile organic compounds at the South DeKalb and NR-285 sites. Acrolein is analyzed using this method. The graph to the right shows this data.

Average Acrolein Concentration (ppb)

Legend: 2016 | 2017 | 2018 | 2019 | 2020
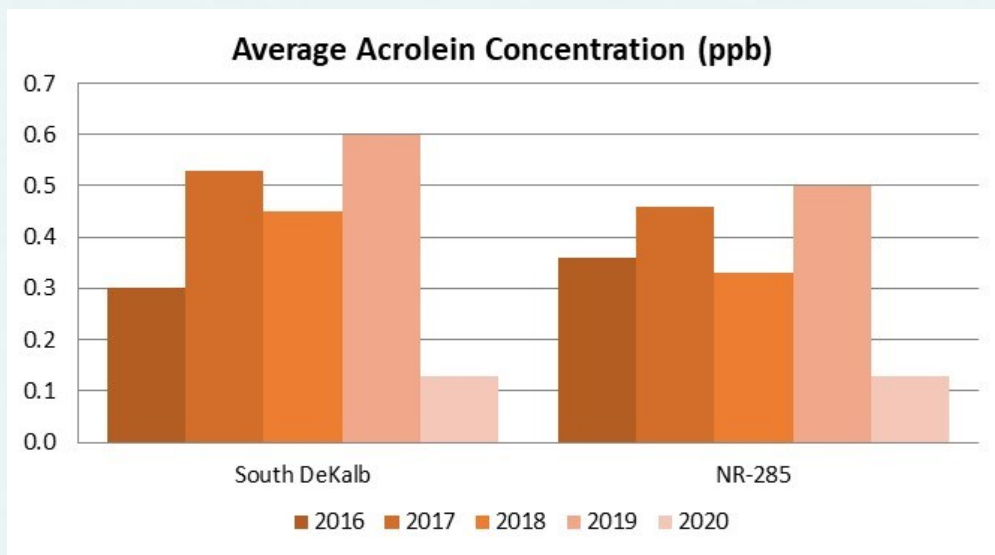
Figure 50. Acrolein concentrations, 2016-2020

AIR TOXICS MONITORING

Air Toxics are monitored where EPD would like to expand the understanding of the quality of Georgia's air regarding ambient concentrations of hazardous air pollutants.

Air Toxics are those pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects.

Air toxic pollutants, or hazardous air pollutants (HAPs), are a group of air pollutants that have a wide variety of sources—mobile sources (such as vehicles), stationary industrial sources, small area sources, indoor sources (such as cleaning materials), and other environmental sources (such as volcanoes and wildfires). The lifetime, transportation, and make-up of these pollutants are affected by both weather (rain and wind) and landscape (mountains and valleys). In addition, some HAPs that are no longer used, but were commonly used in the past, can still be found in the environment today.

Negative effects on human health range from headaches, nausea, and dizziness to cancer, birth defects, problems breathing, and other serious illnesses. These effects can vary depending on frequency of exposure, length of exposure time, health of the person that is exposed, along with the toxicity of the compound.

People can be exposed to HAPs by breathing contaminated air, consuming food or water contaminated by air pollutants, or touching contaminated water or soil.

Some of the substances tend to have only one critical effect, while others may have several. Some of the effects may occur after a short exposure and others appear after long-term exposure, or many years after being exposed.
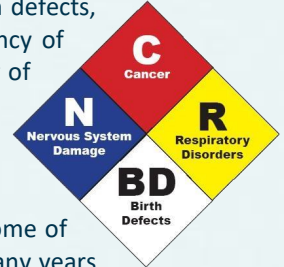
These air pollutants also affect the environment. Wildlife experience symptoms similar to those in humans and pollutants accumulate in the food chain. Many air pollutants can also be absorbed into waterways and have toxic effects on aquatic wildlife.

From the list of 187 HAPs compounds identified by EPA, toxic compounds monitored include metals, volatile organic compounds (VOCs), semi-volatile organic compounds (semi-VOCs), and carbonyl compounds.

NATTS

The National Air Toxics Trends Station (NATTS) network was established in 2003 at the South DeKalb site and is intended for long-term operation for the purpose of discerning national trends. The NATTS Network consists of 27 sites nationwide, 20 urban and 7 rural. A risk assessment is performed on the air toxics monitoring data. In addition to the NATTS site, EPD operates a VOCs sampler at the NR-285 site (mapped below).
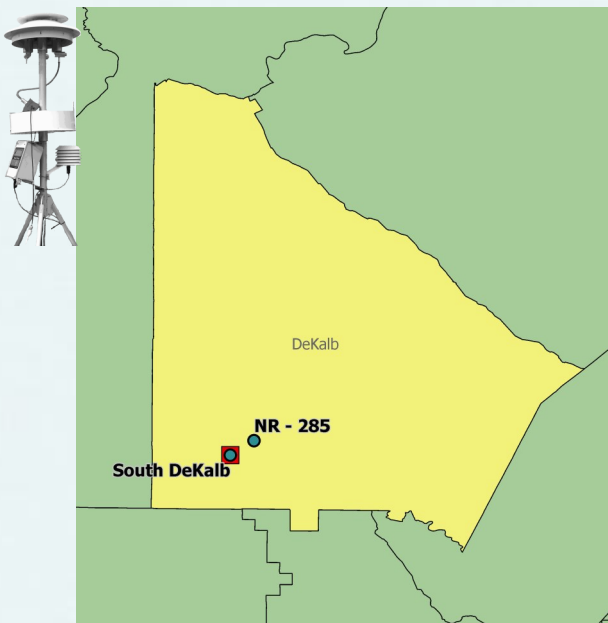
Monitoring Techniques

- The PM$_{10}$ metals sampler collects quartz fiber filters that are analyzed on an inductively coupled plasma mass spectrometry (ICP-MS).[19]

- PUF (polyurethane foam) sampler is used for sampling semi-volatile organic compounds (SVOCs)—A multi-layer cartridge is prepared which collects both the particulate fraction and the volatile fraction of this group of compounds, analyzed using a gas chromatograph.[19]

- The canister sampler for VOCs is analyzed using a gas chromatograph with mass spectroscopy detection (GC/MS).[20,21]

- Carbonyls are collected with absorbent cartridge filled with dinitrophenylhydrazine (DNPH), using High Performance Liquid Chromatography analysis, as discussed on the previous page.

MORE INFORMATION ABOUT MEASUREMENT TECHNIQUES
[19] https://tisch-env.com/high-volume-air-samplers/
[20] https://xonteck.com/
[21] http://www.atec-online.com/atec_003.htm

Figure 51. Air Toxics monitoring sites, NATTS site indicated by red box

METALS

Sources include:
- gasoline and diesel exhaust
- batteries
- soil and water
- burning coal
- emissions from iron and steel production
- lead smelters
- operation of iron and steel production plants
- by-product of mining and smelting sulfide ores
- used in industrial processes
- tires
- radioactive metal in radiotherapy
- photocells and solar panels

South DeKalb Metals

VOLATILE ORGANIC COMPOUNDS

South DeKalb and NR-285 VOCs
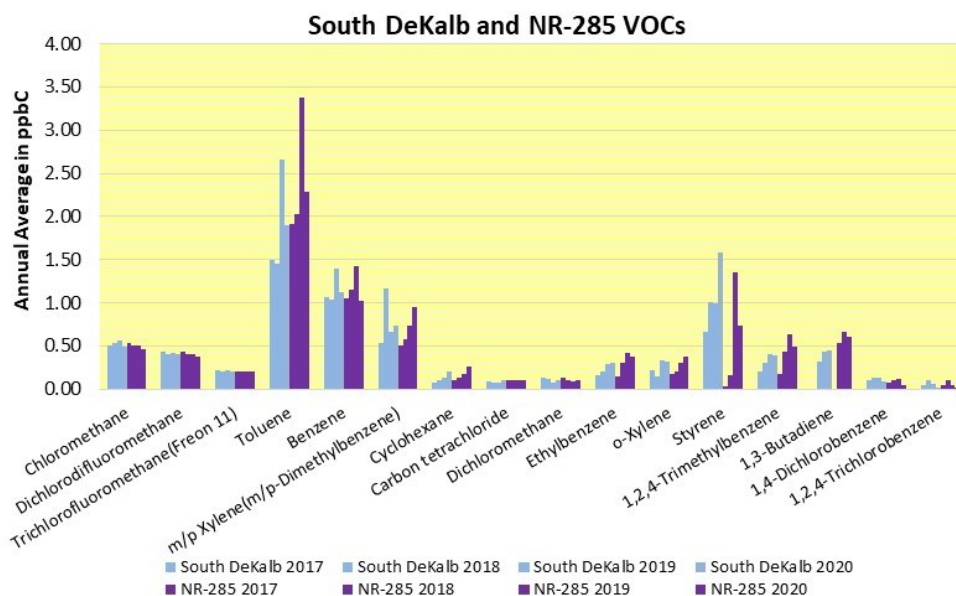
Sources include:
- various industrial, stationary and mobile sources

SEMI-VOLATILE ORGANIC COMPOUNDS

Sources include:
- burning of coal, oil, gas, and garbage
- found in dyes, cigarette smoke, coal tar, plastics, and pesticides
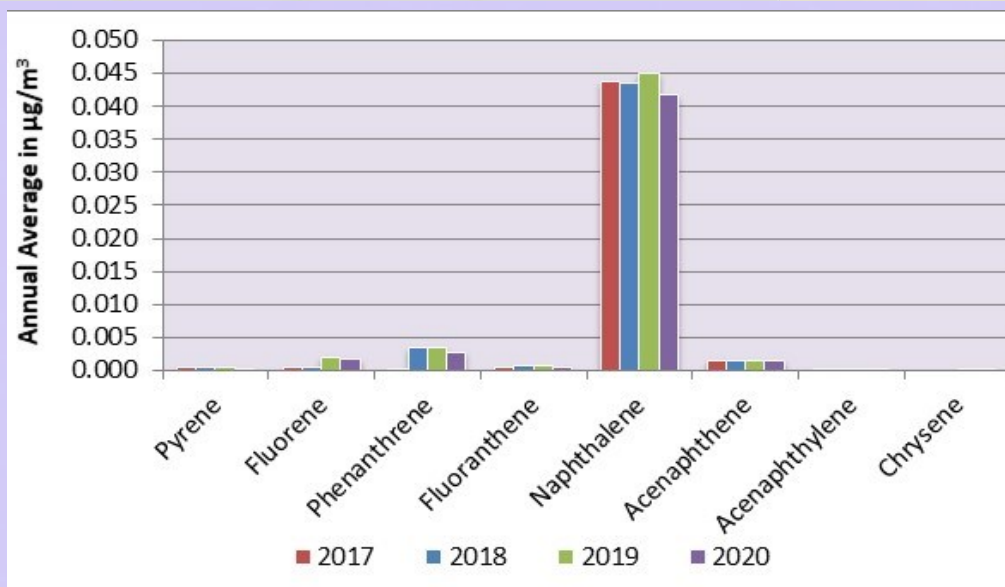
Figure 52. Air Toxics Data

Near-Road VOCs

The NR-285 site is set up as part of the Near-Road Monitoring Network and is located within 40 meters of I-285, a heavily traveled interstate. The South DeKalb site is approximately a mile away from the NR-285 site and is located 580 meters from the same interstate.

The following scatterplots and correlations were created to compare select VOCs that had several pollutant detections at both the South DeKalb and NR-285 sites.
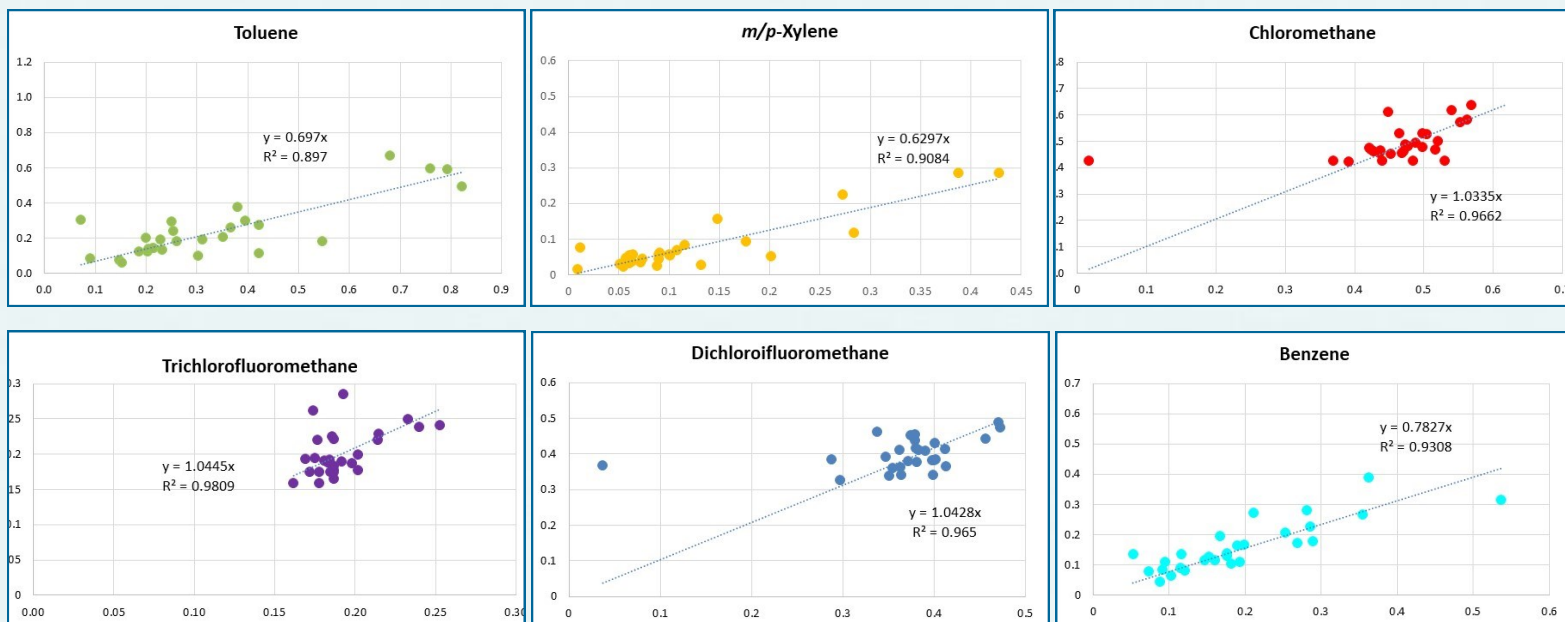
VOC	Correlation Coefficient (r)
Toluene	0.8189
m/p-Xylene	0.8948
Chloromethane	0.4848
Trichlorofluoromethane	0.5022
Dicholrodifluoromethane	0.3939
Benzene	0.8364

The correlations between the South DeKalb and NR-285 sites show that these six VOCs pollutants are highly correlated (with R^2 values >0.9), especially toluene, xylenes, and benzene. These three pollutants are found in gasoline. In the above graphs, this is indicated by the colored dots falling closely along the blue trendline.

Figure 53. Comparison of select VOCs at the South DeKalb and NR-285 sites

RISK ASSESSMENT

The 2020 Air Toxics Risk Assessment was prepared by the Risk Assessment Program of EPD to understand whether long-term exposure to specific air toxics in ambient (outdoor) air around two air monitoring sites (South DeKalb and NR-285) in the State of Georgia could be harmful to human health. The risk assessment is included as Appendix D of this document.

For questions, please contact:

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Risk Assessment Program

Land Protection Branch-Hazardous Waste Management

GA EPD

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METEOROLOGICAL REPORT

State Climatology and Meteorological Summary of 2020

- The climate across North and Central Georgia varies based on a variety of factors, the most prominent of which is terrain.

- The Gulf of Mexico and the Atlantic Ocean are the two nearby maritime bodies that exert an important influence on the South Georgia climate, acting as major sources of moisture support.

- A complete suite of meteorological instrumentation is used to characterize meteorological conditions around metropolitan Atlanta. See Appendix B for details.
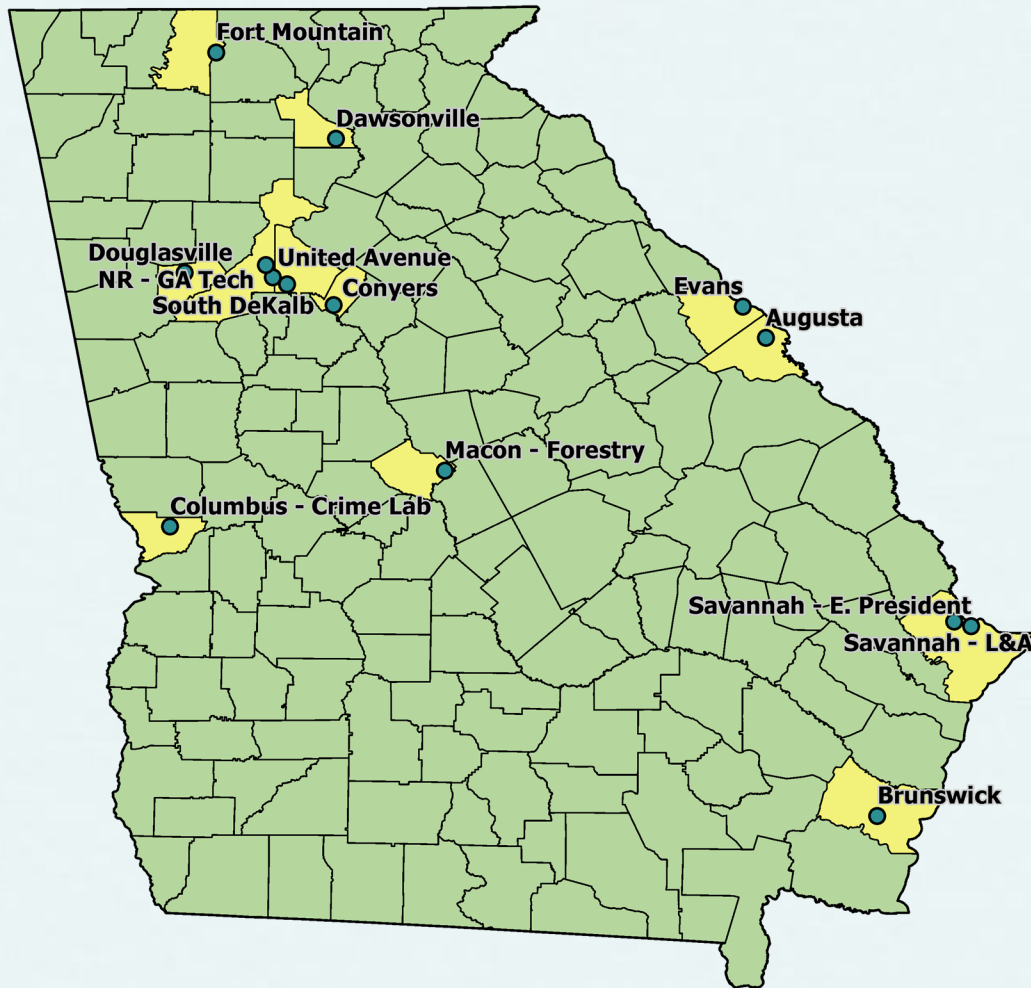
Figure 54. Meteorological Site Map

Figure 55. Sample meteorological instrumentation at EPD sites:
a) ceilometer, b) sonic anemometer, c) Temperature probe and relative humidity monitor, d) tipping bucket

2020 Severe Weather

- Weather conditions for 2020 consisted of above normal rainfall and warmer than average temperatures for north and central Georgia.

- Severe storms on the 11th and 14th of January led to five confirmed tornadoes across eastern Paulding/western Cobb, Fannin, Upson, Pike and Spalding counties.

- Heavy rainfall from severe storms in February caused several climate sites to break their all-time records for daily rainfall in February on the 6th.

- A fast-moving system on February 8th dropped 6 to 7 inches of snow over the north Georgia mountains.

- A strong storm system led to an outbreak of severe weather on Easter across the South, spawning 21 confirmed tornadoes across north and central Georgia from April 12th through 13th, including two EF-3 tornadoes.
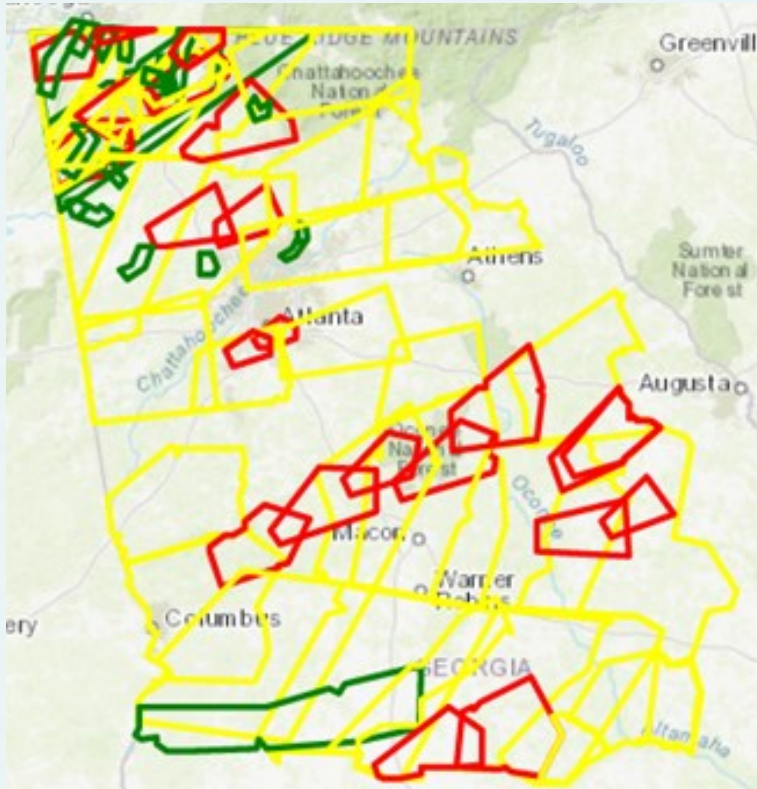
Figure 56. Warnings issued on April 12-13th, 2020 (left) and local storm reports issued from the event (right) across north and central Georgia (Source:National Weather Service)

2020 Severe Weather (continued)

- Remnants of Hurricane Sally moved across portions of north and central Georgia on September 16th and 17th. Atlanta, Athens, Columbus, and Macon all broke daily precipitation records.

Figure 57. Storm total rainfall from the remnants of Hurricane Sally across portions of north and central Georgia (Source: National Weather Service)

- Athens, Atlanta, and Macon all experienced top 10 warmest years on record.
- Athens, Atlanta, Columbus, and Macon all experienced top 10 wettest years on record.

For more information regarding the Georgia Climate Office, see https://epd.georgia.gov/office-state-climatologist.

2020 Drought Conditions for Georgia

- Above normal precipitation and several tropical systems kept Georgia nearly drought free for the entire year.

- At the beginning of August, high temperatures and localized precipitation left 55% of the state abnormally dry with less than 3% designated as D1 (moderate drought). The drought conditions were improved by rainfall from several tropical systems including Hurricane Isaias, Hurricane Laura, and Hurricane Marco. Storms were at either Tropical Storm or Tropical Depression stage when their outer rainbands propagated into Georgia.
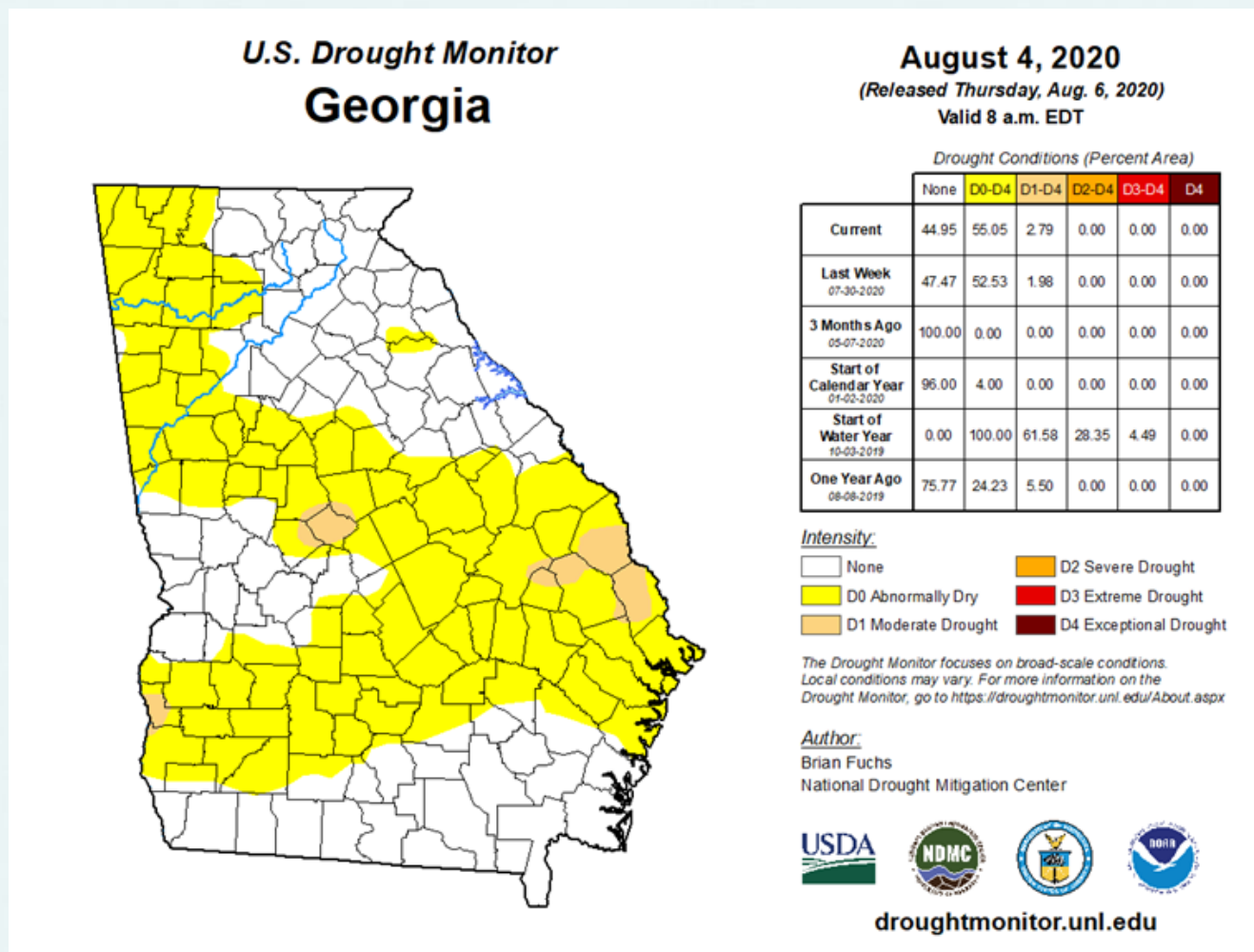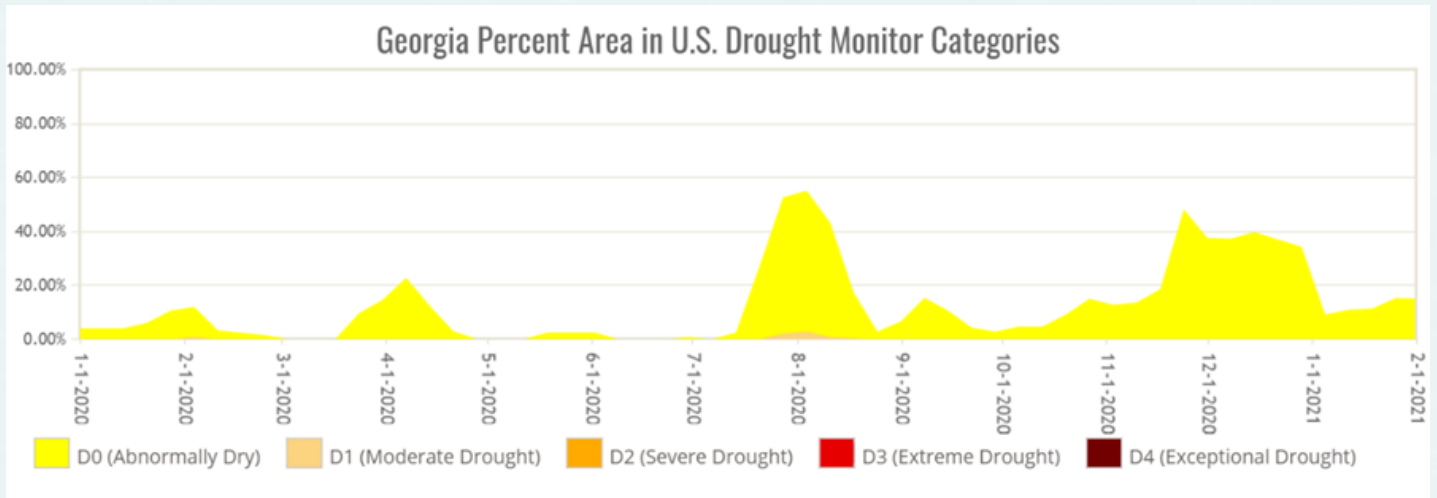
Figure 58. Drought Conditions in Georgia

Agricultural Impacts

- In January and February, short supplies of hay due to the flash drought in the previous year and limited grazing potential due to saturated grounds brought difficulties to the farmers. The Spring onion crop struggled with disease because wet conditions prevented application of fungicide. Conditions improved in March.

- Multiple fruit crops were damaged when freezing conditions occurred in north Georgia in April. Multiple heavy rain episodes limited fieldwork in some counties in May and June. High temperatures and lack of rainfall in late July and early August put some stress on the crops. Conditions improved in September.

- Hurricane Zeta reduced the time farmers were able to spend in fields near the end of October. High winds and heavy rain caused some trees to fall. Farmers in the northern part of the state noted multiple freezes in November. In December, above normal rainfall in certain areas affected planting/harvesting activities. Freezing temperatures and heavy rain caused pasture conditions to be sloppy.

- Corn for grain production was 70.2 million bushels, an increase of 25 percent from 2019. Cotton production was 2.18 million bales, down 20 percent from 2019 due primarily to a reduction in planted acreage. Peanut production, at 3.28 billion pounds, was up 19 percent from 2019 due to an increase in planted acreage. Soybean production, at 3.90 million bushels, was up 56 percent from 2019. Tobacco harvested acres was at the lowest level since 1918 with production totaled 19.3 million pounds.

Characteristics of the 2020 Air Quality Seasons and Forecasting in Atlanta, Macon, and Columbus, Georgia

- Statistics are based on team daily predicted and final daily observed continuous ozone (daily peak 8-hour average) and pre-liminary and final PM (daily 24-hour average) data. Observed data were retrieved from the US EPA AirNow Tech database (www.airnowtech.org) on 4/12/2021. Note: the following analyses include only days on which there are records for both observed and predicted values. In 2020, there were 366 possible days in the PM2.5 season (January 1 – December 31), and 214 days in the ozone season (April 1 – October 31).

Table 2: Observed Air Quality in 2020

Metro Area and Pollutant	Total # of days in record	Observed # of Days in AQI Category			
		Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy
Atlanta Ozone	214	180	33	1	0
Macon Ozone	211*	208	3	0	0
Atlanta PM$_{2.5}$	366	253	111	2	0
Columbus PM$_{2.5}$	366	297	68	1	0

Notes:

Total number of days in record based on AirNow data for observed measurements.

* In Macon in 2020, AirNow does not have any observed ozone data for 9/17, 10/5, and 10/20.

Table 3: Predicted Air Quality in 2020

	Hits	Misses	False Alarms	Bias	Gross Error	Correlation (-1 to +1)	% Accurate 2 categories	% Accurate 5 categories
Atlanta Ozone	0	1	6	2.1 ppbv	5.7 ppbv	0.78	99.5	83
Macon Ozone	0	0	0	3.3 ppbv	6.2 ppbv	0.75	100	97
Atlanta PM$_{2.5}$	0	2	0	-0.6 µg/m^3	2.6 µg/m^3	0.59	99.2	78
Columbus PM$_{2.5}$	0	1	0	-0.6 µg/m^3	2.5 µg/m^3	0.56	99.5	84

Notes:

Hits are the number of days on which an observed exceedance of the daily NAAQS was correctly predicted.

Misses are the number of days on which an observed exceedance of the daily NAAQS was not predicted.

False Alarms are the number of days on which an exceedance of the daily NAAQS was predicted, but was not later observed.

Bias is the average tendency to over-predict (positive bias) or under-predict (negative bias) the observed pollutant concen-tration.

Gross Error is the average absolute error of the predictions relative to the observations.

Correlation is a measure of the ability to predict the relative change in observed concentrations. Higher positive correlation implies that the predictions are accurately anticipating changes in the observed concentrations.

% Accurate 2 categories is the percentage of days when the forecast prediction correctly matched the observation for the "no smog alert" / "smog alert" condition (i.e. 2 categories).

% Accurate 5 categories is the percentage of days when the forecast prediction correctly matched the observation for five categories of the Air Quality Index (Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy, and Very Unhealthy).

Observed and Predicted Air Quality:
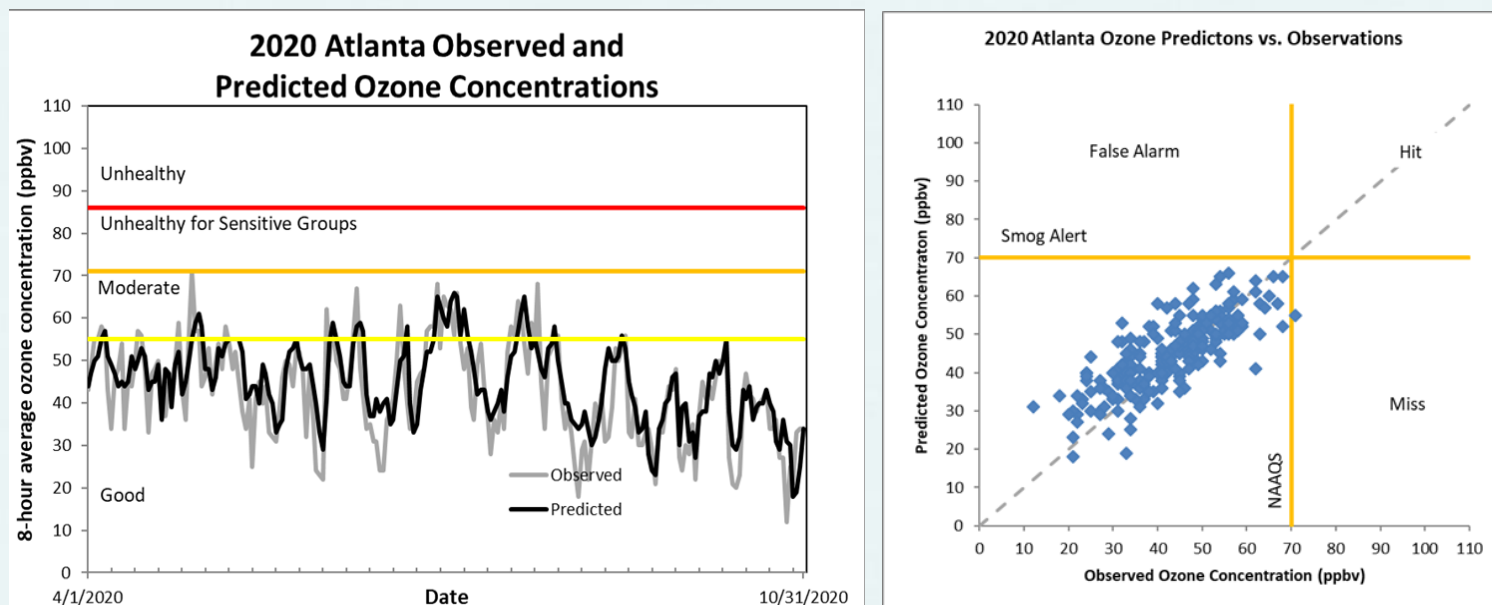
Figure 59. Atlanta observed and predicted ozone, 2020
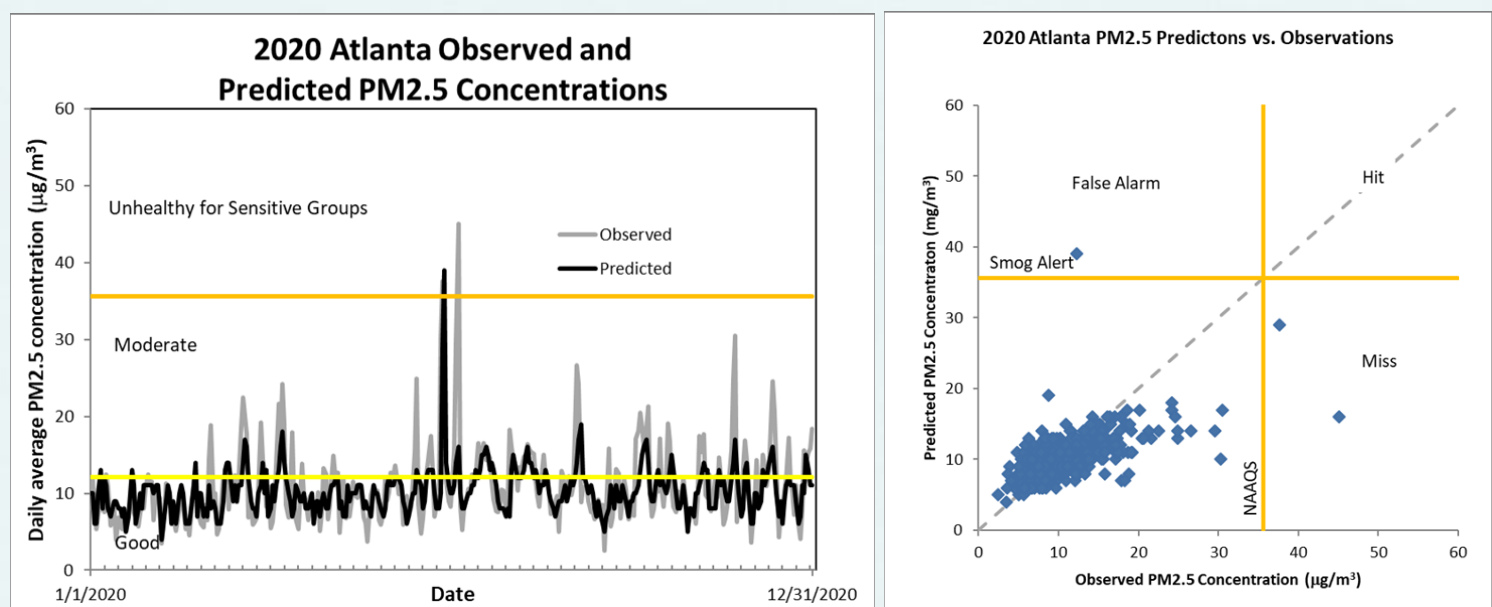
Figure 60. Atlanta observed and predicted PM$_{2.5}$, 2020

Observed and Predicted Air Quality:
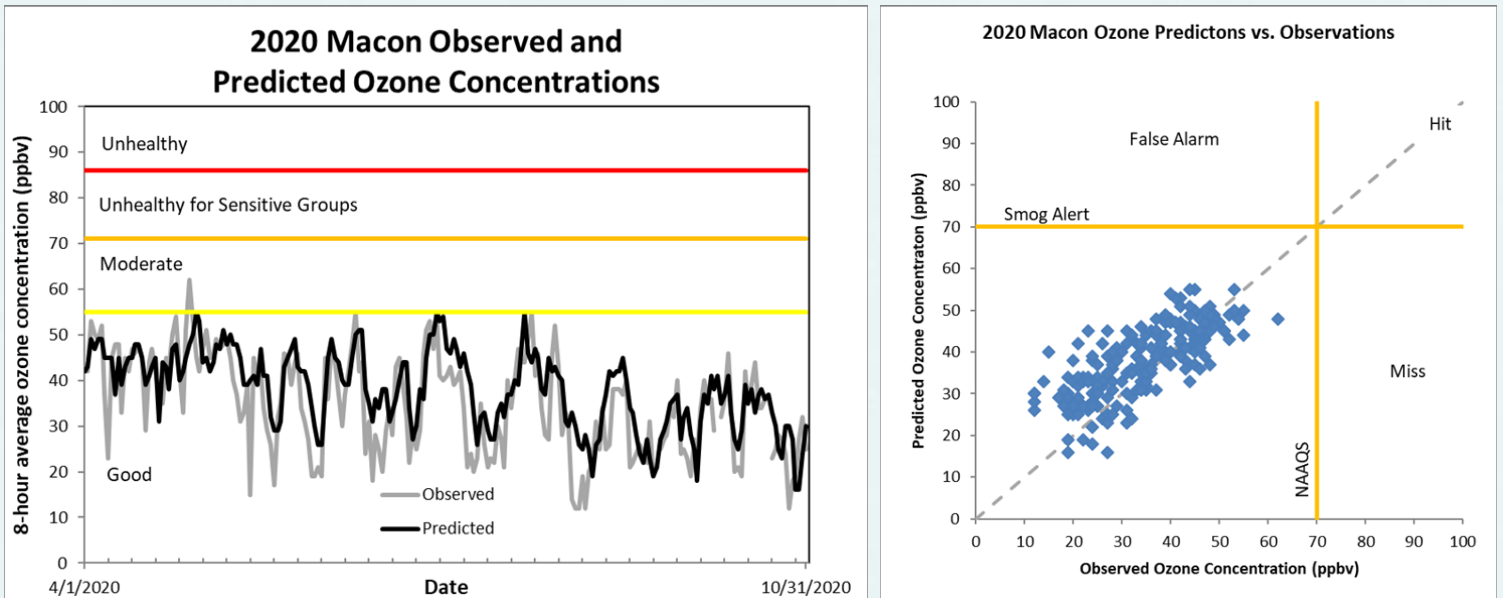
Figure 61. Macon observed and predicted ozone, 2020
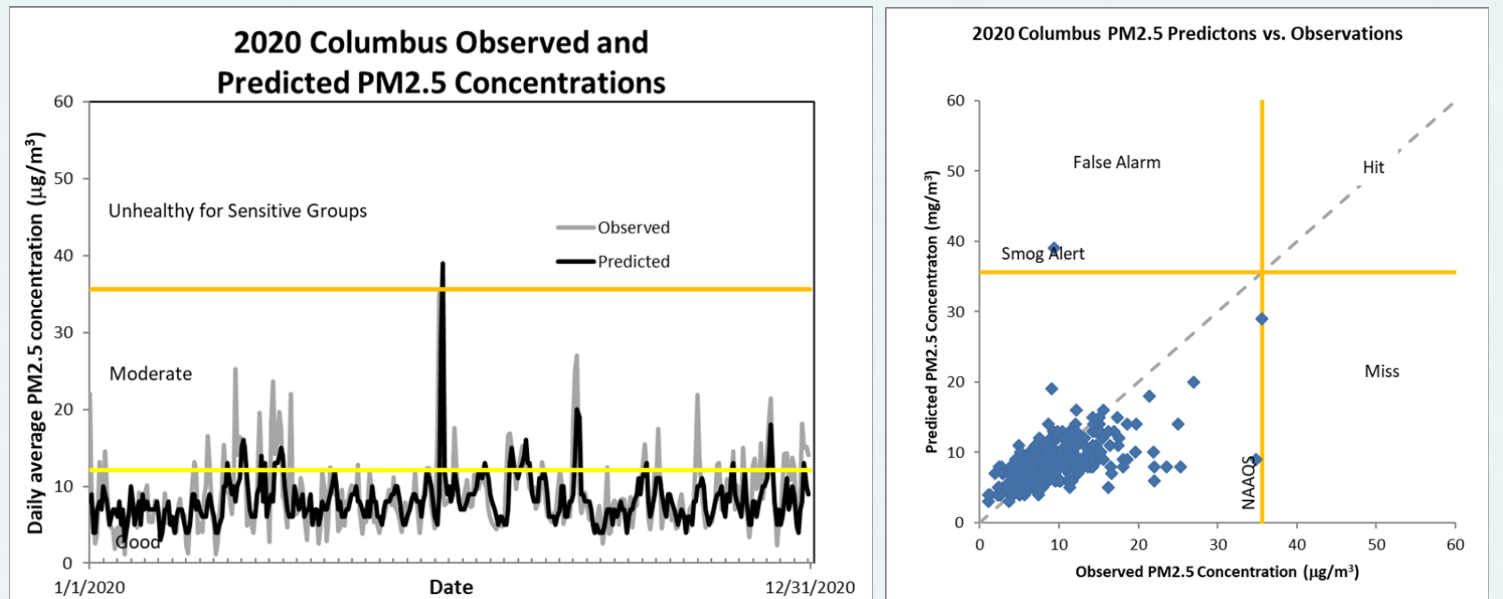
Figure 62. Columbus observed and predicted PM₂.₅, 2020
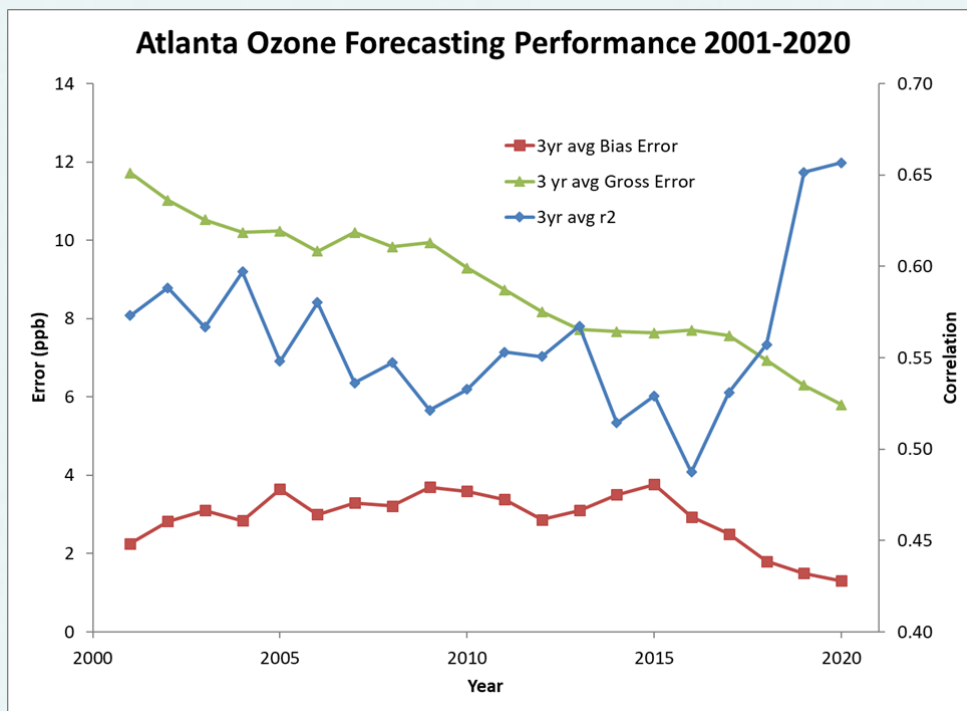
Figure 63. Atlanta ozone forecasting performance 2001-2020

- By all measures, air quality forecasting continues to trend towards greater accuracy. Figure 63 shows the 3-year running average of the mean normalized bias (MNB), mean normalized error (MNE), and correlation coefficient (r2) for ozone forecasting in Atlanta since 2001 (note: 1999 was the first year the team began forecasting next day peak 8-hour ozone concentrations, so 2001 is the first year that a 3-yr average is available). The trends show that the team continues to become more accurate in its forecasts: the gross error (a measure of how much the team tends to err in its estimate of the next day's peak ozone concentration without regard to whether that estimate overpredicts or underpredicts the observed value) has almost been cut in half and continues to decline. Bias (a measure of how much the team tends to err in its estimate of the next day's peak ozone concentration accounting for the overprediction or underprediction of the observed value) is also at an all-time low. Meanwhile, correlation (a measure of the skill in predicting the relative change in observed concentrations) has increased over the last several years and now stands at an all-time high.

- Similar, though not as pronounced, trends towards improved accuracy are also noted for PM: recent gross error is lower to flat relative to previous years, and correlation is increased. Curiously, bias error has trended to negative meaning the forecasting team tends to under-predict observed PM concentrations, whereas in earlier years, the team tended to overpredict PM concentrations.
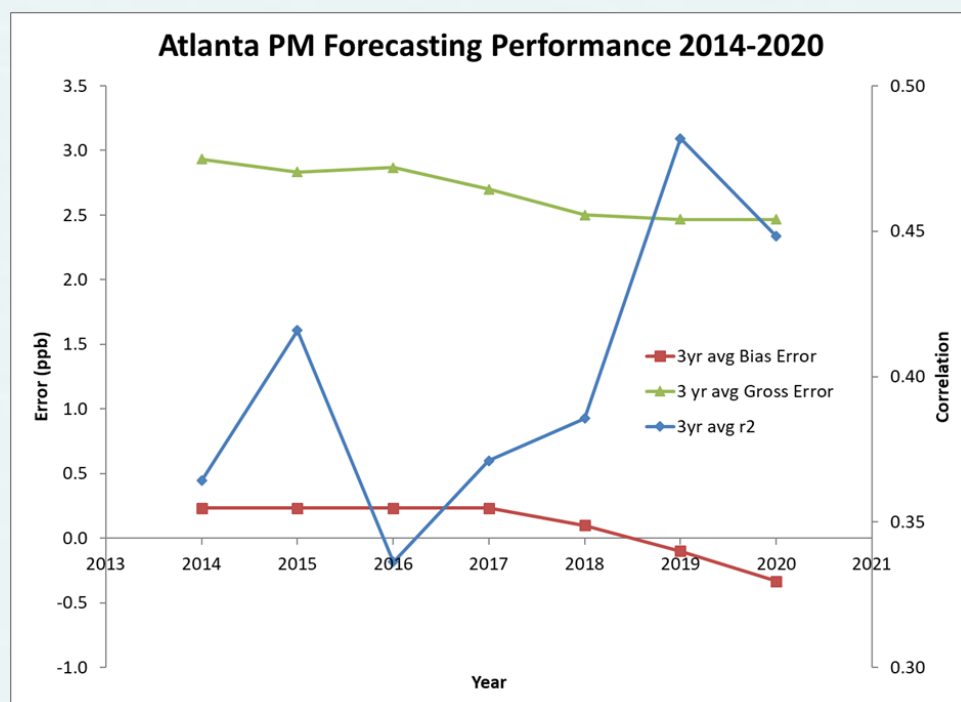
Figure 64. Atlanta PM forecasting performance 2014-2020

- Despite the general forecasting accuracy, the team continues to experience difficulty predicting exceedances. In 2020, there were only 4 exceedance events (one ozone NAAQS exceedance and two PM NAAQS exceedances in Atlanta, and a single PM NAAQS exceedance in Columbus), and none of them were correctly predicted. Though the cause of the events are often readily explained after the fact, the information that explains them is not usually available prior to the event – especially in the case of PM exceedances caused by prescribed burning. The team and the models they rely on have the ability to anticipate when and where burning may occur, but this is based more on intuition and experience than real data. Until better information is available about when and where prescribed burns are going to occur prior to their ignition, air quality forecasting may have reached a plateau in terms of accuracy.

Quality Assurance/Quality Control Program

The purpose of the QA/QC Program is to assure the quality of data from EPD's air monitoring network. The GA EPD meets or exceeds the QA requirements defined in 40 CFR 58 and all applicable appendices. With the QA Program, GA EPD independently challenges the ambient air monitors to ensure they meet the requirements of 40 CFR 58.

The QA/QC program includes but is not limited to the following activities:

- Instrument performance audits
- Monitor siting evaluations
- Precision and span checks
- Bias determinations
- Flow rate determinations
- Leak checks
- Data validation

For additional independent quality assurance activities, the EPD participates in EPA's National Performance Audit Program (NPAP) and Performance Evaluation Program (PEP) for criteria pollutants. EPD's samplers are compared on a national basis through these independent audits.

As the Primary Quality Assurance Organization (PQAO) for ambient air monitoring activities in Georgia, the Ambient Monitoring Program operates under an EPA approved Quality Management Plan and utilizes Quality Assurance Project Plans (QAPPs) for each state wide monitoring network. The primary purpose of the QAPP is to provide an overview of the project, describe the need for the measurements and define QA/QC activities to be applied to the project. All other ambient air monitoring initiatives, including state and industrial projects, must have an approved monitoring plan for each specific project.

The two following graphs show how GA EPD's criteria audit data compare to EPA's target limits. Each target limit is shown in the box below each graph for each pollutant.

Accuracy Levels

Pollutant	CO	NO2	O3	SO2
Lower (25%) Confidence Limit	0.07%	1.85%	-2.47%	-9.12%
Median Confidence Limit	0.67%	2.35%	-1.72%	-3.76%
Mean Confidence Limit	0.67%	3.80%	-1.77%	-4.59%
Upper (75%) Upper Confidence Limit	1.28%	5.03%	0.44%	-0.75%
Targeted Percent Difference	±15%	±15%	±15%	±15%
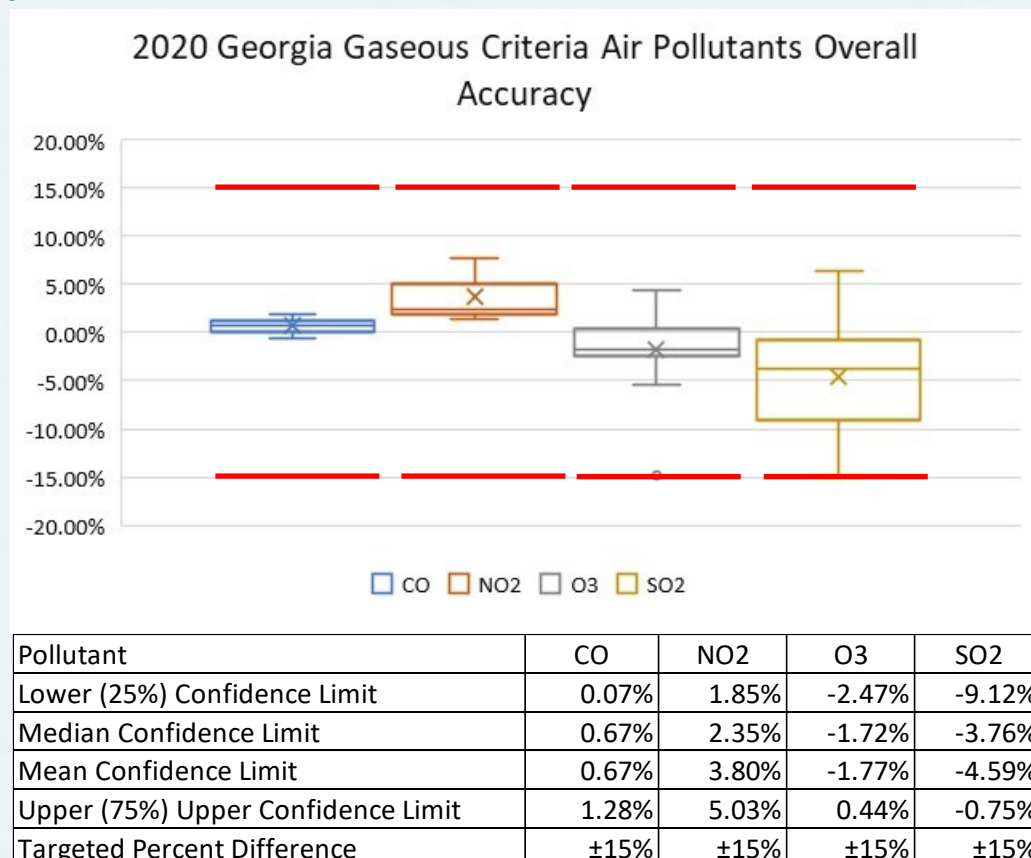
Figure 65. Gaseous Air Pollutants 2020 Accuracy Data

Accuracy Levels

Pollutant	PM2.5	PM10	Pb
Lower (25%) Confidence Limit	0.45%	-0.02%	-0.73%
Median Confidence Limit	1.08%	0.39%	-0.26%
Mean Confidence Limit	0.97%	0.40%	-0.26%
Upper (75%) Upper Confidence Limit	1.72%	0.81%	0.20%
Targeted Percent Difference	±4%	±7%	±7%
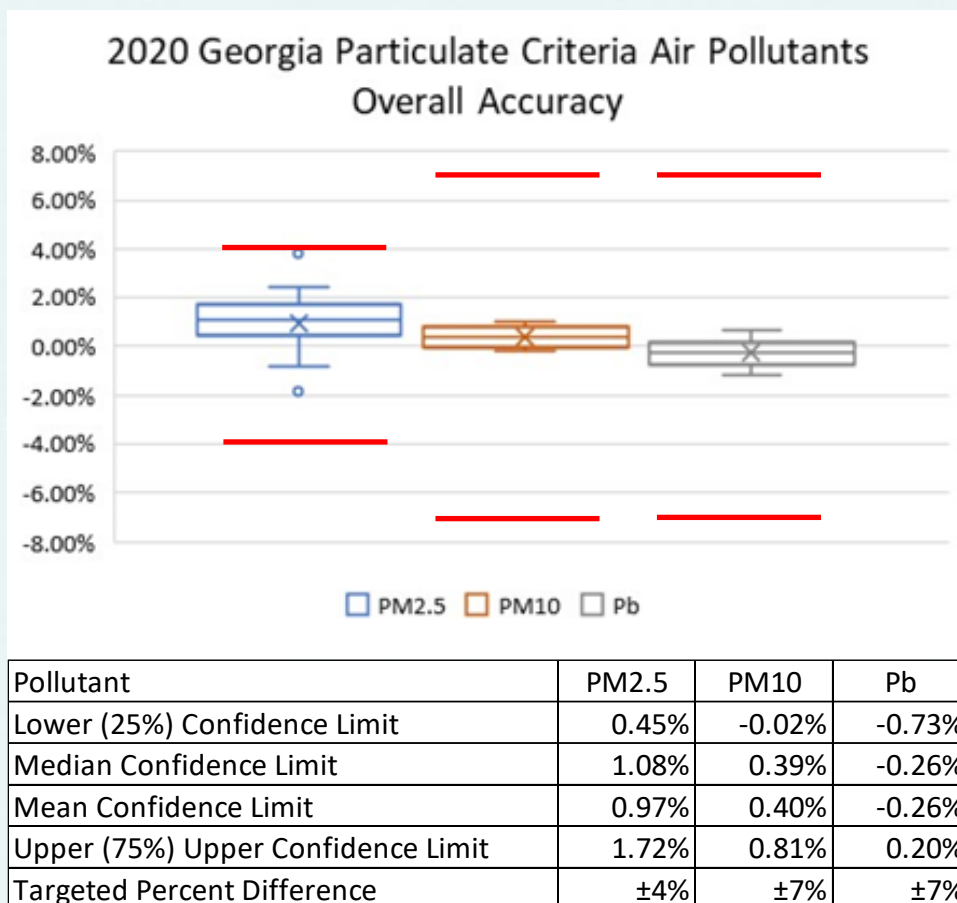
Figure 66. Particulate Air Pollutants 2020 Accuracy Data

Appendix Section

Appendix A: Georgia Air Monitoring Network

SITE ID	Site Name	COUNTY	O3	CO	PM2.5 FRM	PM2.5 Cont.	PM2.5 Spec.	PM Coarse	NOx	NO2	NOy	SO2	Pb	PM10	PM10 Cont.	PAMS VOC	VOC	SVOC	Carbonyls	Met	Black Carbon	Metals
Rome MSA																						
131150003	Rome	Floyd				S	X															
131150006	Kraftsman^	Floyd										S								NR		
Brunswick MSA																						
131270006	Brunswick	Glynn	S		S															NR		
Valdosta MSA																						
131850003	Valdosta	Lowndes			S	S																
Warner Robins MSA																						
131530001	Warner Robins	Houston			S	S																
Dalton MSA																						
132130003	Fort Mountain	Murray	S																	NR		
Albany MSA																						
130950007	Albany	Dougherty			S*	S																
Gainesville MSA																						
131390003	Gainesville	Hall				S																
Athens-Clark County MSA																						
130590002	Athens	Clarke	S			S*	X															
Macon MSA																						
130210007	Macon-Allied	Bibb			S*		X															
130210012	Macon-Forestry	Bibb	S		S	S						S								NR		
Columbus Georgia- Alabama MSA																						
132150001	Columbus-Health Dept.^	Muscogee			S																	
132150008	Columbus-Airport	Muscogee	S		S	S																
132150009	Columbus-Allied^	Muscogee											S*									
132150011	Columbus-Cusseta^	Muscogee			S		X						S									
132151003	Columbus-Crime Lab	Muscogee																			NR		
Savannah MSA																						
130510021	Savannah-E. President St.	Chatham	S									S								NR		
130511002	Savannah-L&A	Chatham				S						S								NR		
Augusta Georgia-South Carolina MSA																						
130730001	Evans	Columbia	S																	NR		
132450091	Augusta	Richmond	S			S	X					S		S						NR		

*QA monitor located at site

^Shut down in 2020

Monitoring Types: S=SLAMS; P=PAMS; C=NCore; X=Supplemental Speciation; T=STN; N=NATTS; R=Near-Road; NR=Non-Regulatory; A=CASTNET

SITE ID	Site Name	COUNTY	O₃	CO	PM2.5 FRM	PM2.5 Cont.	PM2.5 Spec.	PM Coarse	NO/NOx	NO₂	NOy	SO₂	Pb	PM₁₀	PM₁₀ Cont	PAMS VOC	VOC	SVOC	Carbonyls	Met	Black Carbon	Metals
Atlanta-Sandy Springs-Roswell MSA																						
130630091	Forest Park	Clayton			S																	
130670003	Kennesaw	Cobb	S		S																	
130850001	Dawsonville	Dawson	S																		NR		
130890002	South DeKalb	DeKalb	S/P/C	S/P/C	S/C*	S/C	T/C	C	S/P	S/P	S/P/C	C			C	P	N	N	P/N	P	N	N
130890003	NR-285	DeKalb							R	R							R					R
130970004	Douglasville	Douglas	S																		NR		
131210039	Fire Station #8	Fulton			S									S*								
131210055	United Ave.	Fulton	S			S						S									NR		
131210056	NR-GA Tech	Fulton		R	R	R			R	R											R	R
131350002	Gwinnett Tech	Gwinnett	S			S																	
131510002	McDonough	Henry	S			S																	
132319991	EPA CAST-NET	Pike	A																				
132470001	Conyers	Rockdale	S/P																		P		
Chattanooga Tennessee-Georgia MSA																						
132950002	Rossville^	Walker			S	S	X																
Not In An MSA																						
130550001	Summerville	Chattooga	S																				
130690002	General Coffee	Coffee			S		X											S					
132611001	Leslie	Sumter	S																				
133030001	Sandersville	Washington				S																	

*QA monitor located at site

^Shut down in 2020

Monitoring Types: S=SLAMS; P=PAMS; C=NCore; X=Supplemental Speciation; T=STN; N=NATTS; R=Near-Road; NR=Non-Regulatory; A=CASTNET

Appendix B: Meteorological Instruments Used in 2020

PARAMETER	COMPANY	INSTRUMENT	MODEL	LOCATION													
				Augusta	Brunswick	Col Cr Lab	United Ave.	Conyers	Dawsonville	S. DeKalb	Sav. E. Pres	Macon Forestry	Douglasville	Ft. Mtn	Evans	NR-GT	Sav L&A
Wind Speed/Wind Direction	R.M. Young	Ultrasonic Anemometer	81000	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ambient Temperature/ Relative Humidity	R.M. Young	TEMP/RH SENSOR, DEG C	41382VC	X		X		X		X	X			X	X		
Barometric Pressure	R.M. Young	Barometric Pressure Sensor	61302V	X		X		X		X	X						
Precipitation	Novalynx	Tipping Bucket Rain Gauge	260-2501	X		X		X		X							
Solar Radiation	Eppley Lab	Standard Precision Pyronometer	PSP/SPP 38380F3					X									
Total Ultraviolet Radiation	Eppley Lab	Total Ultraviolet Radiometer	TUVR 38020					X									
Data Logger	ESC	Data System Controller	8832	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Towers	Aluma Tower Inc.	Crank-Up Tower	T-135	X	X	X	X	X		X	X	X	X			X	X
	Aluma Tower Inc.	Fold-Over Tower	FOT-10						X					X	X		

Appendix C: Pollutant Concentrations

National Ambient Air Quality Standards for Carbon Monoxide

Primary NAAQS: 8-hour average not to exceed 9 ppm more than once per year

Secondary NAAQS: None

Criteria Pollutant Summary Report - 2020

Pollutant: Carbon Monoxide

Data Interval: Hourly   **Units:**   Parts per million (ppm)

Site ID	City	County	Site Name	Hours Measured	Max 1 - Hour		Obs. > 35	Max 8 - Hour		Obs. > 9
					1st	2nd		1st	2nd	
130890002	Decatur	DeKalb	South DeKalb	8607	1.645	1.58	0	1.5	1.4	0
131210056	Atlanta	Fulton	NR-GA Tech	8555	2.5	2.2	0	1.9	1.8	0

National Ambient Air Quality Standards for Nitrogen Dioxide

Primary NAAQS: Annual mean must not exceed 53 ppb

3-year average of the 98th percentile of daily maximum one-hour averages must not exceed 100 ppb

Secondary NAAQS: Annual mean must not exceed 53 ppb

Criteria Pollutant Summary Report - 2020

Pollutant: Nitrogen Dioxide

Data Interval: Hourly   **Units:**   Parts per billion (ppb)

Site ID	City	County	Site Name	Hours Measured	98th%	Max 1-Hour		Annual Arithmetic Mean
						1st	2nd	
130890002	Decatur	DeKalb	South DeKalb	8395	37.9	41	40.9	7.52
130890003	Atlanta	DeKalb	NR-285	5642	42.2	53	47.3	14
131210056	Atlanta	Fulton	NR-GA Tech	8543	41.3	47.8	46.2	15.53

Pollutant Summary Report - 2020

Pollutant: NO

Data Interval: Hourly   **Units:** Parts per billion (ppb)

Site ID	City	County	Site Name	Hours Measured	Max 1-Hour		Annual Arithmetic Mean
					1st	2nd	
130890002	Decatur	DeKalb	South DeKalb	8320	239.2	212.7	10.34
130890003	Decatur	DeKalb	NR-285	8277	279.0	272.5	19.14
131210056	Atlanta	Fulton	NR-GA Tech	7402	213.5	211.3	20.25

Pollutant Summary Report - 2020

Pollutant: NOx

Data Interval: Hourly   **Units:** Parts per billion (ppb)

Site ID	City	County	Site Name	Hours Measured	Max 1-Hour		Annual Arithmetic Mean
					1st	2nd	
130890002	Decatur	DeKalb	South DeKalb	8395	227.7	211.3	15.66
130890003	Atlanta	DeKalb	NR-285	8642	325.5	325	33.46
131210056	Atlanta	Fulton	NR-GA Tech	8543	206.6	206.3	37.37

Pollutant Summary Report - 2020

Pollutant: NOy

Data Interval: Hourly   **Units:** Parts per billion (ppb)

Site ID	City	County	Site Name	Hours Measured	Max 1-Hour		Annual Arithmetic Mean
					1st	2nd	
130890002	Decatur	DeKalb	South DeKalb	8304	200	200	14.49

Primary NAAQS: 3-year average of 4th highest daily maximum 8-hr concentration not to exceed 0.070 ppm

Secondary NAAQS: Same as the Primary Standards

Criteria Pollutant Summary Report - 2020

Pollutant: Ozone

Data Interval: Hourly **Units:** Parts per million (ppm)

8-Hour Averages

Site ID	City	County	Site Name	Days Meas-ured	1st Max	2nd Max	3rd Max	4thMax	Number of Days >0.070
130210012	Macon	Bibb	Macon-Forestry	242	0.062	0.055	0.055	0.054	0
130510021	Savannah	Chatham	Savannah-E. Pres. St.	244	0.059	0.055	0.054	0.054	0
130550001	Summerville	Chattooga	Summerville	244	0.057	0.053	0.052	0.052	0
130590002	Athens	Clarke	Athens	243	0.063	0.056	0.056	0.056	0
130670003	Kennesaw	Cobb	Kennesaw	244	0.063	0.058	0.057	0.056	0
130730001	Evans	Columbia	Evans	240	0.055	0.055	0.054	0.052	0
130850001	Dawsonville	Dawson	Dawsonville	244	0.062	0.059	0.057	0.057	0
130890002	Decatur	DeKalb	South DeKalb	363	0.066	0.065	0.062	0.061	0
130970004	Douglasville	Douglas	Douglasville	244	0.063	0.059	0.056	0.056	0
131210055	Atlanta	Fulton	United Ave.	242	0.069	0.065	0.064	0.063	0
131270006	Brunswick	Glynn	Brunswick	243	0.056	0.055	0.052	0.052	0
131350002	Lawrenceville	Gwinnett	Gwinnett Tech	244	0.071	0.068	0.068	0.066	1
131510002	McDonough	Henry	McDonough	244	0.067	0.061	0.059	0.058	0
132130003	Chatsworth	Murray	Fort Mountain	236	0.058	0.058	0.057	0.057	0
132150008	Columbus	Muscogee	Columbus-Airport	242	0.063	0.055	0.054	0.053	0
132319991	Williamson	Pike	CASTNET	235	0.059	0.057	0.055	0.054	0
132450091	Augusta	Richmond	Augusta	239	0.060	0.060	0.057	0.056	0
132470001	Conyers	Rockdale	Conyers	243	0.063	0.062	0.061	0.060	0
132611001	Leslie	Sumter	Leslie	238	0.059	0.059	0.056	0.054	0

Criteria Pollutant Summary Report - 2020

Pollutant: Ozone

Data Interval: Hourly   Units: Parts per million (ppm)

1-Hour Averages

Site ID	City	County	Site Name	Days Measured	1st Max	2nd Max
130210012	Macon	Bibb	Macon-Forestry	245	0.074	0.071
130510021	Savannah	Chatham	Savannah-E. Pres. St.	245	0.066	0.065
130550001	Summerville	Chattooga	Summerville	245	0.062	0.060
130590002	Athens	Clarke	Athens	245	0.070	0.063
130670003	Kennesaw	Cobb	Kennesaw	245	0.073	0.071
130730001	Evans	Columbia	Evans	241	0.064	0.058
130850001	Dawsonville	Dawson	Dawsonville	245	0.072	0.067
130890002	Decatur	DeKalb	South DeKalb	364	0.086	0.083
130970004	Douglasville	Douglas	Douglasville	244	0.069	0.068
131210055	Atlanta	Fulton	United Ave.	243	0.084	0.081
131270006	Brunswick	Glynn	Brunswick	245	0.063	0.061
131350002	Lawrenceville	Gwinnett	Gwinnett Tech	245	0.081	0.081
131510002	McDonough	Henry	McDonough	245	0.071	0.071
132130003	Chatsworth	Murray	Fort Mountain	239	0.062	0.061
132150008	Columbus	Muscogee	Columbus- Airport	243	0.067	0.062
132319991	Williamson	Pike	CASTNET	239	0.069	0.063
132450091	Augusta	Richmond	Augusta	242	0.067	0.066
132470001	Conyers	Rockdale	Conyers	244	0.073	0.072
132611001	Leslie	Sumter	Leslie	241	0.065	0.064

Criteria Pollutant Summary Report - 2020

Pollutant: Sulfur Dioxide

Data Interval: Hourly

Units: Parts per billion (ppb)

Site ID	City	County	Site Name	Hours Measured	Max 24 - Hour		Max 3 - Hour		Max 1-Hour		99th Pctl 1- Hr	Maximum 5-Minute Average	Annual Arithmetic Mean
					1st	2nd	1st	2nd	1st	2nd			
130210012	Macon	Bibb	Macon-Forestry	8700	1.2	1.1	2	1.5	5	2.5	2.2	4.0	0.48
130510021	Savan-nah	Chat-ham	Savannah-E. Pres. St	8433	7.5	7.2	28.8	18.2	33.4	24.6	21.2	75.3	1.43
130511002	Savan-nah	Chat-ham	Savannah-L&A	8632	21.2	18.8	45.3	44.4	93.2	67.1	64.4	148.7	1.44
130890002	Decatur	DeKalb	South DeKalb	8568	1.8	1.8	2.5	1.8	2.9	1.9	1.9	4.8	0.10
131150006	Rome	Floyd	Kraftsman	8649	3.6	3.3	10.9	9.3	19.3	13.7	10.8	66.7	0.75
131210055	Atlanta	Fulton	United Ave.	8600	2.1	2.1	3.2	2.7	4.2	3.7	3.3	7.9	0.89
132450091	Augusta	Rich-mond	Augusta	8624	9.5	8.2	50.9	38.2	87.4	83.1	58.2	214.8	0.60

Criteria Pollutant Summary Report - 2020

Pollutant: Particulate Matter PM$_{2.5}$

Data Interval: 24-Hour   Units: Micrograms per cubic meter (µg/m^3)

98th% and Annual Arithmetic Mean

Integrated Sampling (midnight to midnight) Using Federal Reference Method

Site ID	City	County	Site Name	Days Measured	98th Percentile	Values Exceeding Applicable Daily Standard	Annual Arithmetic Mean
130210007	Macon	Bibb	Macon-Allied	116	16.6	0	8.14
130210012	Macon	Bibb	Macon-Forestry	115	16.0	0	6.67
130630091	Forest Park	Clayton	Forest Park	121	24.1	0	8.15
130670003	Kennesaw	Cobb	Kennesaw	120	23.5	0	8.20
130690002	General Coffee	Douglas	General Coffee	120	15.9	0	6.79
130890002	Decatur	DeKalb	South DeKalb	121	24.8	0	7.99
130950007	Albany	Dougherty	Albany	120	23.5	0	8.53
131210039	Atlanta	Fulton	Fire Station #8	122	24.1	0	8.14
131210056	Atlanta	Fulton	NR-GA Tech	121	24.5	0	9.46
131270006	Brunswick	Glynn	Brunswick	107	16.0	0	7.74
131530001	Warner Robins	Houston	Warner Robins	110	14.6	0	7.05
131850003	Valdosta	Lowndes	Valdosta	119	17.9	1	7.87
132150001	Columbus	Muscogee	Columbus-Health Dept.	121	23.0	0	8.44
132150008	Columbus	Muscogee	Columbus-Airport	121	19.0	0	8.10
132150011	Columbus	Muscogee	Columbus-Cusseta	69	18.2	0	7.40
132950002	Rossville	Walker	Rossville	59	14.9	0	6.96

	National Ambient Air Quality Standards for Particulate Matter $PM_{2.5}$
Primary NAAQS:	3-year average of the annual weighted mean not to exceed 12.0µg/m^3
	3-year average of the 98th percentile of 24-hour concentration not to exceed 35µg/m^3
Secondary NAAQS:	3-year average of the annual weighted mean not to exceed 15.0µg/m^3
	3-year average of the 98th percentile of 24-hour concentration not to exceed 35µg/m^3

Pollutant Summary Report - 2020

Pollutant: Particulate Matter $PM_{2.5}$

Data Interval: 1-Hour   **Units:**   Micrograms per cubic meter (µg/m^3)

Hourly Averages of $PM_{2.5}$ with Federal Equivalent Method (FEM)

Site ID	City	County	Site Name	Days Measured	98th Percentile	Values Exceeding Applicable Daily Standard	Annual Arithmetic Mean
130210012	Macon	Bibb	Macon-Forestry	366	18.2	0	7.60
130511002	Savannah	Chatham	Savannah-L&A	365	18.3	0	8.90
130590002	Athens	Clarke	Athens	361	19.7	0	8.37
130890002	Decatur	DeKalb	South DeKalb	365	19.8	0	8.93
130950007	Albany	Dougherty	Albany	358	27.9	2	10.38
131350002	Lawrenceville	Gwinnett	Gwinnett Tech	361	21.0	0	8.31
131390003	Gainesville	Hall	Gainesville	359	18.8	0	8.66
131530001	Warner Robins	Houston	Warner Robins	361	21.3	1	9.54
131850003	Valdosta	Lowndes	Valdosta	236	22.6	0	8.74
132450091	Augusta	Richmond	Augusta	325	22.8	1	10.69
132950002	Rossville	Walker	Rossville	236	18.2	0	8.22
133030001	Sandersville	Washington	Sandersville	353	20.9	2	8.70

Pollutant Summary Report - 2020

Pollutant: Particulate Matter $PM_{2.5}$

Data Interval: 1-Hour   Units: Micrograms per cubic meter ($\mu g/m^3$)

Hourly Averages of $PM_{2.5}$ with Non-FEM Method

Site ID	City	County	Site Name	Hours Measured	1st Max	2nd Max	Annual Arithmetic Mean
131150003	Rome	Floyd	Rome	7812	72.1	64.4	8.16
131210055	Atlanta	Fulton	United Ave.	8171	149.1	142.2	10.59
131210056	Atlanta	Fulton	NR-GA Tech	7960	105.9	89.7	7.48
131510002	McDonough	Henry	McDonough	8662	118.4	96.4	6.51
131850003*	Valdosta	Lowndes	Valdosta	1349	52.0	51.0	7.85
132150008	Columbus	Muscogee	Columbus-Airport	8672	110.6	60.7	7.56

*partial year of data, as method changed

National Ambient Air Quality Standards for Particulate Matter PM$_{10}$

Primary NAAQS: Number of days with a maximum of 24-hour concentration of 150µg/m^3 must not exceed more than once per year on average over 3 years

Secondary NAAQS: Same as the Primary Standards

Criteria Pollutant Summary Report - 2020

Pollutant: Particulate Matter PM$_{10}$

Data Interval: 24-Hour   **Units:** Micrograms per cubic meter (µg/m^3)

24-Hour Integrated Measurements

Site ID	City	County	Site Name	Days Measured	1st Max	Number Values ≥150	Annual Arithmetic Mean
131210039	Atlanta	Fulton	Fire Station #8	60	51	0	15.2

Hourly Continuous Measurements

Site ID	City	County	Site Name	Hours Measured	1st Max	Annual Arithmetic Mean
130890002	Decatur	DeKalb	South DeKalb	8556	79	17.1
132450091	Augusta	Richmond	Augusta	8706	73	10.8

National Ambient Air Quality Standards for Lead

Primary NAAQS: Rolling 3-month average not to exceed 0.15 µg/m^3

Secondary NAAQS: Same as the Primary Standard

Criteria Pollutant Summary Report - 2020

Pollutant: Lead

Data Interval: 24-Hour   **Units:** Micrograms per cubic meter (µg/m^3)

Site ID	132150009	132150011
City	Columbus	Columbus
County	Muscogee	Muscogee
Site Name	Columbus-Allied	Columbus-Cusseta
Number of Obs.	61	33
Nov 2019-Jan 2020	0.0047	0.0019
Dec 2019-Feb 2020	0.0054	0.0018
Jan 2020-Mar 2020	0.0056	0.0014
Feb 2020-Apr 2020	0.0051	0.0013
Mar 2020-May 2020	0.0040	0.0014
Apr 2020-Jun 2020	0.0035	0.0015
May 2020-Jul 2020	0.0027	0.0015
Jun 2020-Aug 2020	0.0025	
Jul 2020-Sep 2020	0.0028	
Aug 2020-Oct 2020	0.0026	
Sep 2020-Nov 2020	0.0112	
Oct 2020-Dec 2020	0.0118	
# of Values $\geq$ 0.15	0	0

2020 Metals					
(concentrations in micrograms per cubic meter ($\mu g/m^3$))					
Name	Site	#Samples	Avg.	1st Max	2nd Max
Antimony	South DeKalb	61	0.0022	0.0102	0.0059
Arsenic	South DeKalb	58	0.0009	0.0066	0.0040
Beryllium	South DeKalb	58	0.0000	0.0004	0.0002
Cadmium	South DeKalb	55	0.0001	0.0003	0.0003
Chromium	South DeKalb	55	0.0015	0.0032	0.0028
Cobalt	South DeKalb	58	0.0000	0.0007	0.0001
Lead	South DeKalb	55	0.0016	0.0090	0.0050
Manganese	South DeKalb	61	0.0040	0.0353	0.0079
Nickel	South DeKalb	61	0.0007	0.0021	0.0012
Selenium	South DeKalb	61	0.0003	0.0014	0.0010

2020 Semi-Volatile Compounds					
(concentrations in μg/m^3)					
Name	Site	#Samples	Avg.**	1st Max	2nd Max
Acenaphthene	South DeKalb	60	0.0015	0.0052	0.0050
Acenaphthylene	South DeKalb	60	0.0002	0.0011	0.0010
Anthracene	South DeKalb	60	0.0004	0.0067	0.0053
Benzo(a)anthracene	South DeKalb	60	0.0000	0.0003	0.0002
Benzo(a)pyrene	South DeKalb	60	0.0000	0.0003	0.0002
Benzo(b)fluoranthene	South DeKalb	60	0.0001	0.0005	0.0005
Benzo(e)pyrene	South DeKalb	60	0.0001	0.0003	0.0002
Benzo(g,h,i)perylene	South DeKalb	60	0.0001	0.0003	0.0003
Benzo(k)fluoranthene	South DeKalb	60	0.0000	0.0003	0.0002
Chrysene	South DeKalb	60	0.0001	0.0004	0.0003
Dibenzo(a,h)anthracene	South DeKalb	60	0.0000	0.0004	0.0001
Fluoranthene	South DeKalb	60	0.0006	0.0015	0.0014
Fluorene	South DeKalb	60	0.0017	0.0051	0.0049
Indeno(1,2,3-cd)pyrene	South DeKalb	60	0.0001	0.0003	0.0003
Naphthalene	South DeKalb	60	0.0418	0.1179	0.1140
Phenanthrene	South DeKalb	60	0.0028	0.0081	0.0067
Pyrene	South DeKalb	60	0.0003	0.0008	0.0007
Perylene	South DeKalb	60	0.0000	0.0003	0.0000

2020 Volatile Organic Compounds					
(concentrations in ppbC)					
Name	Site	#Samples	Avg.	1st Max	2nd Max
Freon 113	South DeKalb*	60	0.12	0.2	0.2
	NR-285	31	0.10	0.2	0.2
Freon 114	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
1,3-Butadiene	South DeKalb*	60	0.45	2.5	1.4
	NR-285	31	0.61	1.6	1.4
Cyclohexane	South DeKalb*	60	0.21	4.0	0.8
	NR-285	31	0.26	3.8	0.5
Ethylene oxide	South DeKalb*	43	0.65	4.2	3.2
Chloromethane	South DeKalb*	60	0.49	0.7	0.7
	NR-285	31	0.46	0.6	0.6
Dichloromethane	South DeKalb*	60	0.10	0.2	0.2
	NR-285	31	0.11	0.2	0.2
Chloroform	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
Carbon tetrachloride	South DeKalb*	60	0.10	0.1	0.1
	NR-285	31	0.10	0.1	0.1
Trichlorofluoro-methane	South DeKalb*	60	0.21	0.63	0.2
	NR-285	31	0.20	0.3	0.2
Chloroethane	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.02	0.0	0.0
1,1-Dichloroethane	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
Methyl chloroform	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0

2020 Volatile Organic Compounds (continued)					
(concentrations in ppbC)					
Name	Site	#Samples	Avg.	1st Max	2nd Max
Ethylene dichloride	South DeKalb*	60	0.01	0.1	0.1
	NR-285	31	0.00	0.1	0.0
Tetrachloroethylene	South DeKalb*	60	0.01	0.1	0.1
	NR-285	31	0.01	0.1	0.1
1,1,2,2-Tetrachloroethane	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
Bromomethane	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
1,1,2-Trichloroethane	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
Dichlorodifluoromethane	South DeKalb*	60	0.40	0.5	0.5
	NR-285	31	0.38	0.5	0.5
Trichloroethylene	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
1,1-Dichloroethylene	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
1,2-Dichloropropane	South DeKalb*	60	0.00	0.1	0.0
	NR-285	31	0.01	0.2	0.2
trans-1,3-Dichloropropene	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
cis-1,3-Dichloropropene	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
cis-1,2-Dichloroethene	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0

2020 Volatile Organic Compounds (continued)					
(concentrations in ppbC)					
Name	Site	#Samples	Avg.	1st Max	2nd Max
Ethylene dibromide	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
Hexachlorobutadiene	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.02	0.0	0.0
Vinyl chloride	South DeKalb*	60	0.00	0.0	0.0
	NR-285	31	0.00	0.0	0.0
m/p Xylene	South DeKalb*	60	0.73	4.5	2.3
	NR-285	31	0.95	3.4	3.1
Benzene	South DeKalb*	60	1.03	4.0	2.3
	NR-285	31	1.12	3.2	2.2
Toluene	South DeKalb*	60	1.90	7.9	5.0
	NR-285	31	2.29	5.8	5.6
Ethylbenzene	South DeKalb*	60	0.30	1.3	0.8
	NR-285	31	0.38	1.0	1.0
o- Xylene	South DeKalb*	60	0.32	1.8	1.0
	NR-285	31	0.37	1.4	1.2
1,3,5-Trimethylbenzene	South DeKalb*	60	0.09	0.4	0.3
	NR-285	31	0.13	0.4	0.4
1,2,4-Trimethylbenzene	South DeKalb*	60	0.39	1.5	1.2
	NR-285	31	0.49	2.0	1.5
Styrene	South DeKalb*	60	1.58	6.8	6.7
	NR-285	31	0.73	2.5	2.5
Benzene,1-ethenyl-4-methyl	South DeKalb*	60	0.09	0.4	0.3
	NR-285	31	0.14	0.4	0.4

2020 Volatile Organic Compounds (continued)					
(concentrations in ppbC)					
Name	Site	#Samples	Avg.	1st Max	2nd Max
Chlorobenzene	South DeKalb*	61	0.00	0.1	0.0
	NR-285	31	0.00	0.1	0.0
1,2-Dichlorobenzene	South DeKalb*	52	0.01	0.1	0.1
	NR-285	31	0.01	0.1	0.1
1,3-Dichlorobenzene	South DeKalb*	50	0.00	0.0	0.0
	NR-285	31	0.00	0.1	0.0
1,4-Dichlorobenzene	South DeKalb*	38	0.09	0.4	0.3
	NR-285	31	0.05	0.2	0.2
Benzyl chloride	South DeKalb*	39	0.00	0.0	0.0
	NR-285	31	0.00	0.1	0.0
1,2,4-Trichlorobenzene	South DeKalb*	49	0.01	0.1	0.1
	NR-285	31	0.01	0.1	0.1

*Sample collected every 6 days

2020 Carbonyl Compounds, 8-hour					
(concentrations in ppbC)					
Name	Site	#Samples	Avg.	1st Max	2nd Max
Formaldehyde	South DeKalb	93	1.75	6.0	5.2
Acetaldehyde	South DeKalb	93	0.70	2.0	2.0
Propionaldehyde	South DeKalb	93	0.19	1.1	0.5
Butyraldehyde	South DeKalb	93	0.5780	4.616	2.824
Acetone	South DeKalb	93	1.13	4.3	4.3
Benzaldehyde	South DeKalb	93	0.05	0.9	0.5

2020 Carbonyl Compounds, 24-hour					
(concentrations in ppbC)					
Name	Site	#Samples	Avg.	1st Max	2nd Max
Formaldehyde	South DeKalb*	61	1.25	3.5	2.7
Acetaldehyde	South DeKalb*	61	0.90	3.2	3.2
Propionaldehyde	South DeKalb*	61	0.15	0.4	0.3
Butyraldehyde	South DeKalb*	61	0.2888	0.944	0.942
Acetone	South DeKalb*	61	1.88	7.0	5.0
Benzaldehyde	South DeKalb*	61	0.30	5.3	1.6
Acrolein (with canister method)	NR-285	31	0.13	0.4	0.3
	South DeKalb*	60	0.13	0.5	0.4

* Sample collected every 6 days

2020 Ambient Air Surveillance Report
Air Toxics Risk Assessment

Prepared by Georgia Environmental Protection Division Risk Assessment Program
(RAP)
10-29-2021

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Due to file size, Appendices have not been included with this document. Appendices can be obtained by contacting the Air Protection Branch Ambient Air Monitoring Program. For questions concerning this document, please contact the Risk Assessment Program using the contact information on the Land Protection Branch website:

https://epd.georgia.gov/about-us/land-protection-branch

2020 Ambient Air Surveillance Report Air Toxics Risk Assessment

2020 Ambient Air Surveillance Report Air Toxics Risk Assessment

Acronyms

- $\mu g/m^3$ – micrograms per cubic meter
- AMDL – Alternate Method Detectable Limit
- MaxAMDL – Maximum Alternate Method Detectable Limit
- AAMP – EPD Air Protection Branch Ambient Air Monitoring Program
- ATSDR – Agency for Toxic Substances and Disease Registry
- AQS – Air Quality System
- CA – Contaminant Concentration in Air
- CalEPA – California Environmental Protection Agency Office of Environmental Health Hazard Assessment
- COPCs – Chemicals of Potential Concern
- USEPA, EPA – United States Environmental Protection Agency
- EGLE – Michigan Department of Environment, Great Lakes, and Energy
- EC – Exposure Concentration
- GAEPD, EPD – Georgia Environmental Protection Division
- HEAST - USEPA Superfund Program Health Effects Assessment Summary Table
- HHRA – Human Health Risk Assessment
- HI – Hazard Index
- HQ – Hazard Quotient
- IRSL – State of Michigan Initial Risk Screening Level
- ITSL – State of Michigan Initial Threshold Screening Level
- IUR – Inhalation Unit Risk
- MC – Minimum Detected Concentration
- MDC – Maximum Detected Concentration
- MRL – ATSDR Minimal Risk Levels
- NAAQS – National Ambient Air Quality Standard
- NAATS – National Air Toxics Trends Station
- OAQPS – EPA's Office of Air Quality Planning and Standards
- ppbv – parts per billion by volume
- PRBSA – Preliminary Risk-Based Screening Analysis
- PPRTV – Provisional Peer-Reviewed Toxicity Value
- RAP – EPD Risk Assessment Program
- RfC – Reference Concentration
- RSL – USEPA May 2021 Resident Air Regional Screening Level
- SVOC – Semivolatile Organic Compound
- UCL – Upper Confidence Limit of the Arithmetic Mean
- VOC – Volatile Organic Compound

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Important Definitions

- Alternate Method Detectable Limit (AMDL): "*method detectable limit (MDL) defined for the sample by the QA agency, which supersedes the EPA-defined method detectable limit for the designated methodology*"[1]. AAMP is considered the QA agency for the purposes of this Assessment.

- Air Toxics: Defined "*Any air pollutant that causes or may cause cancer, respiratory, cardiovascular, or developmental effects, reproductive dysfunctions, neurological disorders, heritable gene mutations, or other serious or irreversible chronic or acute health effects in humans.*" (USEPA, 2004, glossary).

- Ambient Air: generally defined as that "*portion of the atmosphere, external to buildings, to which the general public has access*" (GAEPD, 2020, pg. 20).

- Cancer Risk: also referred to as the "incremental risk of cancer" or "risk"; the predicted risk of cancer "*from the exposure being analyzed that is above the risk that the individuals in the population have already (i.e., due to non-air toxics related issues)*" (USEPA, 2004; pg. 13-5).

- Chemicals of Potential Concern (COPCs): All air toxics that were determined in the PRBSA to potentially pose an unacceptable cancer risk and/or noncancer hazard and which have been further evaluated in the HHRA.

- Cumulative Cancer Risk: The total cancer risk which is obtained by summing the cancer risk of individual chemicals.

- Contaminant Concentration in Air (CA): For a particular air toxic, estimated as the upper confidence limit of the arithmetic mean (UCL) of all valid (useable) sample values collected over the year 2020. The CA is an upper-bound estimate of the chronic (long-term) ambient air concentration of an air toxic within the spatial scale of an air monitoring Site.

- Exposure Concentration (EC): Generally defined as the "*concentration of a chemical in the air at the point where a person breathes the air*" (USEPA, 2004, pg. 6-17). In the context of this Assessment, the EC is a time-weighted contaminant concentration in air (CA) which considers the frequency, duration, and time of exposure as well as the time over which the exposure is averaged (USEPA, 2009, pg. 13 to 17).

- Hazard: Also referred to as "noncancer hazard". Defined as the potential harm from noncarcinogenic air toxics (USEPA, 2004; pg. 13-4).

- Hazard Index (HI): A value which describes the total noncancer hazard which is derived by summing the hazard quotients (HQs) determined for individual air toxics.

- Hazard Quotient (HQ): "*The ratio of a single substance exposure level over a specified time period (e.g., chronic) to a reference value (e.g., an RfC) for that substance derived from a similar exposure period*" (USEPA, 2004, glossary). Please see the text for more information on how HQs were determined in this Assessment.

- High-End Exposure Estimate: "*plausible estimate of individual exposure or dose for those persons at the upper end of an exposure or dose distribution*" (USEPA, 2004,

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[1] Please see: https://aqs.epa.gov/aqsweb/documents/AQS_Data_Dictionary.html

glossary). In this Assessment, a high-end exposure estimate is considered to be an estimate of the reasonable maximum exposure (RME).

- Inhalation Unit Risk (IUR): "*the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 µg/m^3 in air*" (USEPA, 2009, pg. 10).
- Maximum Detected Concentration (MDC): largest concentration of a particular air toxic's detected and useable sample values.
- Reasonable Maximum Exposure (RME): "*highest exposure that is reasonably expected to occur at a site*" (USEPA, 1989a; pg. 6-5).
- Risk Manager: "*persons or groups with the authority to make the decisions about the acceptability of risk and how an unacceptable risk may be mitigated, avoided, or reduced*" (USEPA, 2004, pg. 5-10).
- Reference Concentration (RfC): "*defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer health effects during a lifetime*" (USEPA, 1994; pg. 1-2 to 1-4).
- Resident Air Regional Screening Level (RSL): Conservative air screening levels developed by USEPA. The lower of the Cancer/Carcinogenic RSL derived at a cancer risk of 10^{-6} (cancerRSL) and Noncancer/Noncarcinogenic RSL derived at a hazard quotient of 0.1 (noncancerRSL) are used in determining the COPCs in the PRBSA.
- Spatial Scale: "*area around the monitoring location (and the types of exposures) the analysts consider the monitoring data to represent*" (USEPA, 2004, pg. 6-14).
- Upper Confidence Limit (UCL): the "*upper boundary (or limit) of a confidence interval of a parameter of interest such as the population mean*" (USEPA, 2015a; pg. 22).

Disclaimer

Every effort has been made to use current and technically defensible risk assessment methodologies to prepare the *2020 Air Toxics Risk Assessment* ("Assessment"). However, the methodologies used herein may not necessarily be applicable or relevant when preparing human health or ecological risk assessments required under State or Federal statutes and regulations (e.g. Georgia Hazardous Site Response Act, Resource Conservation and Recovery Act, etc.). Under no circumstances should this Assessment be construed as EPD risk assessment policy. The Assessment does not substitute State or Federal statutes and regulations and is not a regulation itself.

2020 Air Toxics Risk Assessment Summary Factsheet

This short factsheet provides a summary of the *2020 Air Toxics Risk Assessment* ("Assessment") in a question-and-answer format. It is recommended that the Assessment be read in full to better understand the conclusions.

What is the purpose of this Assessment?

The purpose is to understand whether long-term exposure to specific air toxics in ambient (outdoor) air around two (2) air monitoring Sites (South DeKalb and NR-285) in the State of Georgia could be harmful to human health.

Why these locations?

Both the South DeKalb and NR-285 air monitoring Sites have precise instruments that can measure concentrations of air toxics in ambient air, and so monitoring results from these two Sites were available for the Assessment. Federal regulations require that air monitoring Sites follow specific technical criteria so that the measured air toxics concentrations are representative of ambient air concentrations within a defined area around each monitoring Site (known as the spatial scale).

How does this Assessment determine whether air toxics are at levels that could be harmful to human health?

- A determination is made of what the risk assessment will cover. For example, this Assessment only assesses specific air toxics for which data was obtained from South DeKalb and NR-285 in the year 2020.
- The data is screened using screening levels to remove any air toxics from further evaluation that are clearly unlikely to pose a concern to human health. This allows the risk assessment to focus only on those air toxics which may be of concern (chemicals of potential concern, COPCs).
- An exposure concentration, a value that represents "how much" of an air toxic that an individual could be exposed to, is determined for all the COPCs.
- Toxicity values, which indicate how harmful an air toxic is, are obtained from reliable, technically defensible sources.
- The exposure concentration and toxicity value for each air toxic are entered into an equation to produce estimates of cancer risk and noncancer hazard. Calculations are also made to determine whether specific air toxics found to be present in ambient air cumulatively pose an unacceptable cancer risk or noncancer hazard.
- All results are explained. Any technical issues and uncertainties that could affect the reliability of the results are also explained.

What are the findings of this Assessment?

The major findings of this Assessment are:

- Ethylene Oxide was found to have an unacceptable cancer risk that is outside of EPA and EPD's acceptable cancer risk range.
    - The Assessment found that the cancer risk for other air toxics is within EPA and EPD's acceptable cancer risk range.
- The Assessment found that adverse noncancer effects may be of concern based on the exposure concentrations of some air toxics including Acrolein.

Does this Assessment explain whether harmful health effects are due to ambient air in Georgia?

No. This risk assessment cannot determine if an individual diagnosed with cancer or suffering from other adverse health effects developed illness due to the levels of air toxics in ambient air. It is recommended that people consult with a medical professional about personal health concerns.

Does this Assessment explain whether a factory near my house is responsible for air pollution?

No. This Assessment cannot determine the source of the air toxics in ambient air.

How is this Assessment useful?

This Assessment follows technically defensible State and Federal guidance to provide the public with an evaluation of whether the concentrations of specific air toxics in ambient air could pose a human health concern. The risk assessment also provides information that regulators can use, along with other pieces of information, in determining how best to reduce concentrations of harmful air toxics present in ambient air.

Why does the risk assessment only cover 2020?

The data from air monitoring Sites must be processed and quality checked before it is released for use in the risk assessment. Thus, there is a lag between when data is collected and when the risk assessment is published. Please note that a risk assessment is prepared on a yearly basis as the data becomes available.

Section 1: Introduction

The *2020 Air Toxics Risk Assessment* ("Assessment") was prepared on behalf of the Georgia Environmental Protection Division (GAEPD) Air Protection Branch Ambient Air Monitoring Program (AAMP) by the GAEPD Land Protection Branch Risk Assessment Program (RAP). The goal of this Assessment is to assess cancer risk and noncancer hazard resulting from chronic (long-term) exposure to ambient air toxics within the defined spatial scale of the following ambient air monitoring Sites:

- National Air Toxics Trends Station (NATTS): 2390-B Wildcat Road, Decatur, GA, 30034 ["South DeKalb"]
- Near Road Monitoring Network Site: 3073 Panthersville Road, Decatur, GA, 30034 ["NR-285"]

Air toxics samples collected from each monitoring Site in the year 2020 have been used to prepare this Assessment. Section 2 provides a brief explanation about the dataset used to prepare the risk assessment. Section 3 contains the preliminary risk-based screening analysis (PRBSA) on all air toxics analyzed at each of the Sites. The goal of the PRBSA is to create a short-list of chemicals of potential concern (COPCs) by comparing maximum detected concentrations (MDCs) with air screening values. COPCs are air toxics that can potentially present a risk/hazard to human health and are further evaluated in the Human Health Risk Assessment (HHRA) in Section 4. Some of the recommendations made in Version 2 of USEPA Region 4's *A Preliminary Risk-Based Screening Approach for Air Toxics Monitoring Data Sets* (USEPA, 2010) were considered when preparing the PRBSA while the HHRA was primarily prepared in accordance with USEPA's *Air Toxics Risk Assessment Reference Library: Volume 1 Technical Resource Manual* (USEPA, 2004). However, other risk assessment guidance documents have been consulted as necessary to ensure that the Assessment reflects current risk assessment technical recommendations and best practices. Supporting information necessary to understand the conclusions of the PRBSA and HHRA have been referenced or included in the Appendices.

It is important to emphasize that the risks/hazards determined in Section 4 are representative of high-end exposure estimates and that there are uncertainties in these estimates due to several reasons. The Uncertainty Section in Section 5 describes the uncertainties inherent to the *2020 Air Toxics Risk Assessment*.

Section 2: Data Collection and Evaluation

Section 2.1 – Collection and Validation of Ambient Air Samples

The South DeKalb Site is part of the National Air Toxics Trend Stations (NATTS) program, a network of air monitoring Sites throughout the United States which help "*to fulfill the need for long-term air toxics, also known as hazardous air pollutants (HAPs), monitoring data of consistent quality*"[2]. The samples from the South DeKalb site that are being evaluated in this Assessment were "*collected from midnight to midnight for a 24-hour sample, every 6 days*" in the year 2020 (GAEPD, 2020, pg. 24). At the NR-285 Site, samples where volatile organic compounds (VOCs) were analyzed were also collected midnight to midnight for a 24-hour sample but were collected every 12 days in the year 2020. Table 1 lists the number of air toxics that have been evaluated in this Assessment.

Table 1: Number of Air Toxics Assessed in the 2020 Air Toxics Risk Assessment. *The following Table lists the number of metals, semivolatiles, volatile organic compounds, and carbonyls that have been assessed in the* 2020 Air Toxics Risk Assessment.

Ambient Air Monitoring Site	Number of Air Toxics
South DeKalb	Metals (10) Semivolatiles (18) Volatile Organic Compounds (44) Carbonyls (6) Total: 78 air toxics
NR-285	Volatile Organic Compounds (43)

All data is validated by the AAMP Quality Assurance Unit before it was provided to use in this Assessment. Please refer to the *2020 Ambient Air Monitoring Plan* (GAEPD, 2020) and contact AAMP for more information on sampling/analysis methods and quality assurance.

Section 2.2 – Organization of Ambient Air Monitoring Results

Validated monitoring results were organized by monitoring Site and air toxic so that the Assessment could be prepared. Since the monitoring results were coded using EPA's Air Quality System (AQS) codes, the AQS Code List[3] was consulted during the organization process. Unusable sample values, which are qualified with a Null data qualifier, (a list of all data qualifiers can be found in Appendix B) were removed from the dataset and have not been considered when preparing this Assessment. Sample values were assigned as either a detect or non-detect (see Section 2.3). VOC sample values and corresponding Alternate Method Detectable Limits (AMDLs) were provided in units of parts per billion by volume (ppbv) and were converted to units of micrograms per cubic meter (µg/m^3) using the following formula:

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[2] Please see: https://www.epa.gov/amtic/air-toxics-ambient-monitoring#natts
[3] https://www.epa.gov/aqs/aqs-code-list

$$\frac{\text{MW x ppbv}}{24.45}$$

Where:

- MW = Molecular weight of air toxic
- ppbv = Air toxic concentration, in parts per billion by volume
- 24.45 = Constant (see USEPA, 2004, pg. 9-8)

Converted VOC sample results and organized data entry files for all air toxics have been included in Appendix A. AAMP can be contacted for the original dataset.

Section 2.3 – Detects and Non-detects

To determine the chemical concentration in air (CA) using ProUCL (see Section 4.2.1), it was necessary to assign a sample value as either a detect or non-detect. Detection status was determined based on the data qualifiers listed in Appendix B. The only datapoints that have been considered non-detects are those qualified with an ND ("No Value Detected, Zero Reported") or MD ("Value less than the MDL").

Section 3: Preliminary Risk-Based Screening Analysis (PRBSA)

Section 3.1 – Selection of Chemicals of Potential Concern (COPCs)

The purpose of Section 3 is to present a preliminary risk-based screening analysis (PRBSA) on the 2020 ambient air monitoring data. The "*basic concept behind this risk-based initial screening level methodology is to evaluate air monitoring data sets using a framework that is, by design, relatively simple to perform yet conservative (i.e., health protective) in nature*" (USEPA, 2010, pg. 2).

For each air toxic evaluated at each Site, the larger of the maximum detected concentration (MDC) and Maximum Alternate Method Detectable Limit (MaxAMDL) of the air toxic was compared with its respective Screening Value (see Section 3.4). If the larger of the MDC and MaxAMDL exceeds the Screening Value, the air toxic was selected as a chemical of potential concern (COPC) that "*at a minimum, will commonly require a more in-depth analysis (e.g., a more detailed risk assessment) to clarify the potential risks associated with the monitored concentrations*" (USEPA, 2010, pg. 4). Please see Appendix D for the COPC Selection Tables. All COPCs were further evaluated in the Human Health Risk Assessment (HHRA) in Section 4.

Section 3.2 – Maximum Detected Concentration (MDC)

The maximum detected concentration (MDC) is the highest concentration of a particular air toxic's useable and detected sample values. The MDC is used for screening in accordance with USEPA (2010) since it "*is expected to result in a lessened chance that chemicals posing exposures of potential public health concern will be removed from further consideration*" in the HHRA (USEPA, 2010, pg. 7).

Section 3.3. – Maximum Alternate Method Detectable Limit (MaxAMDL)

The Alternate Method Detectable Limit (AMDL) is defined as the "*method detectable limit (MDL) defined for the sample by the QA agency, which supersedes the EPA-defined method detectable limit for the designated methodology*"[4]. For a particular air toxic, the Maximum Alternate Method Detectable Limit (MaxAMDL) is the largest AMDL for that air toxic out of all useable samples.

Section 3.4: Screening Values

The following Screening Values were used in the PRBSA:

- For most of the air toxics evaluated in this Assessment, the <u>lower</u> of an air toxic's respective cancer (carcinogenic) or noncancer (noncarcinogenic) May 2021 USEPA Resident Air Regional Screening Level (RSL) (USEPA, 2021) is used as the Screening Value. Using RSLs, which are updated semi-annually and derived using the most current recommended toxicity values, ensures that the PRBSA is technically defensible. Cancer RSLs (cancerRSLs) are derived at a cancer risk level of $1x10^{-6}$ (1 in 1 million) while noncancer RSLs (noncancerRSLs) are derived at a hazard quotient (HQ) of 0.1[5] and both RSLs are based on residential "*default exposure parameters and factors that represent Reasonable*

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[4] Please see: https://aqs.epa.gov/aqsweb/documents/AQS_Data_Dictionary.html

[5] As stated in Frequent Question #6 in USEPA (2021), the justification for deriving noncancerRSLs at a HQ of 0.1 is "*that when multiple contaminants of concern are present at a site or one or more are present in multiple exposure media, the total hazard index could exceed 1.0 if each were screened at the HQ of 1.0*".

Maximum Exposure (RME) conditions for long-term/chronic exposures" (USEPA, 2021)[6]. The May 2021 Resident Air RSLs have been included in Appendix C. For more information regarding how RSLs are derived, please see the RSL User's Guide (USEPA, 2021).

- Some air toxics do not have a cancerRSL and/or noncancerRSL listed in Appendix C. For these air toxics, a surrogate cancerRSL and/or noncancerRSL was used. A noncancerRSL for Benzo(e)pyrene is not listed on the May 2021 Resident Air RSL Table provided in Appendix C but was derived in the same manner as other noncancerRSLs. Please see the COPC Selection Tables in Appendix D for more information.

- For all other air toxics that do not have a noncancerRSL and/or cancerRSL, Initial Threshold Screening Levels/Initial Risk Screening Levels (ITSLs/IRSLs)[7] were utilized as Screening Values. These values were derived by toxicologists in the Michigan Department of Environment, Great Lakes, and Energy (EGLE) and are used for regulatory purposes in the State of Michigan. Since long-term (chronic) exposure is being evaluated in this Assessment, generally only ITSLs/IRSLs with an "annual" averaging period were used (due to lack of an "annual" ITSL, an 8-hour ITSL was used for Freon 114). The use of these values adds uncertainty to this Assessment. Further discussion on the ITSLs/IRSLs is provided in the Section 5 Uncertainty Section.

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[6] Reasonable maximum exposure (RME) is defined as the "*highest exposure that is reasonably expected to occur at a site*" (USEPA, 1989; pg. 6-5). Though USEPA (2004) does not use the term RME, exposure parameters and factors that represent RME conditions are high-end exposure estimates, meaning that they represent a "*plausible estimate of individual exposure or dose for those persons at the upper end of an exposure or dose distribution*" (USEPA, 2004, glossary). Use of residential exposure parameters and factors that result in an high-end exposure estimate ensure that the RSLs are protective of individuals who might be exposed to ambient air within the spatial scale of a monitoring Site for a lower frequency, time, and duration.
[7] For more information on the State of Michigan Screening Values, please see: https://www.michigan.gov/egle/0,9429,7-135-3310_70487_4105---,00.html and https://www.egle.state.mi.us/itslirsl/legend.html.

Section 4: Human Health Risk Assessment (HHRA)

Section 4.1 - Conceptual Model

The conceptual model "*explicitly identifies the sources, receptors, exposure pathways, and potential adverse human health effects that the risk assessment will evaluate*" (USEPA, 2004, pg. 6-1). This allows risk managers and the public to understand exactly what is being evaluated in this Assessment. USEPA (2004) recommends specific elements that should be included in a conceptual model, which has been graphically displayed in Figure 1 and further explained below.

Source	Multiple sources, including background concentrations
Stressor	COPCs at South DeKalb and NR-285
Exposure Pathway	Exposure to COPCs in ambient air
Exposure Route	Inhalation of ambient air
Subpopulation	Hypothetical resident who would reside for a longer than average time within the spatial scale of each air monitoring Site.
Endpoint	Cancer risk and noncancer hazard
Metrics	Estimated by deriving cancer risk and noncancer hazard estimates for individual chemicals and using these estimates to derive cumulative cancer risk and hazard index

Figure 1: Conceptual Model, Applies to All Monitoring Sites. This conceptual model was made similar to the conceptual model in Exhibit 6-1 of USEPA (2004).

Section 4.1.1 – Sources of Air Toxics

The air toxics present in ambient air are a "*combination of background concentrations and the same chemical released from possibly multiple sources*" (USEPA, 2004, pg. 10-37). However, the exact sources of these air toxics cannot be pinpointed from the air monitoring data used in the HHRA.

Section 4.1.2 – Stressors
The stressors are the specific air toxics that will be evaluated in the HHRA, which are the COPCs determined for each of the monitoring Sites in the PRBSA. Except for Benzaldehyde (which does not have available toxicity values), all other COPCs contribute to the cancer risk and/or noncancer hazard estimates provided in Appendix H.

Section 4.1.3 – Exposure Pathway/Exposure Route
The HHRA only evaluates exposure to COPCs resulting from inhalation of ambient (outdoor) air, defined "*as that portion of the atmosphere, external to buildings, to which the general public has access*" (GAEPD, 2020, pg. 20), since only validated air monitoring data is available. Air toxics present in indoor air has not been evaluated in the HHRA, "*but indoor air concentrations of air toxics are expected to be the same or lower than the outdoor concentrations*" (USEPA, 2004, pg. 11-2). An individual could possibly be exposed to air toxics that have deposited out of the air onto water bodies, plants, soil, and/or other surfaces (USEPA, 2004, pg. 6-2), but other exposure pathways and routes have not been evaluated since atmospheric deposition data is not available.

Section 4.1.4 – Subpopulation
The scale (or "spatial scale") is defined as the "*area around the monitoring location (and the types of exposures) the analysts consider the monitoring data to represent*" (USEPA, 2004, pg. 6-14). AAMP has estimated the spatial scale of each monitoring Site and considers pollutant concentrations to be uniform within the spatial scale of an air monitoring Site (GAEPD, 2020, pg. 20). According to GAEPD (2020), South DeKalb has a Neighborhood spatial scale (an area with dimensions up to 4 kilometers from the monitoring Site), which indicates that air toxics concentrations measured at South DeKalb represent ambient air concentrations within a 4-kilometer radius from the South DeKalb monitoring Site. NR-285 has a Micro spatial scale (an area with dimensions up to 100 meters from the monitoring Site), which means that air toxics concentrations measured at NR-285 represent ambient air concentrations within a 100-meter radius from the NR-285 monitoring Site. Please refer to the relevant monitoring Site descriptions in Appendix A of GAEPD (2020) for maps depicting the spatial scale of each Site.

The risk/hazard estimates provided in Appendix H of the HHRA are representative of a hypothetical resident who inhaling ambient air within the spatial scale of either Site. More specifically, this Assessment assumes that the hypothetical resident is continuously inhaling COPCs in ambient air (assumed to be present at a concentration at the higher end of a range of possible ambient air concentrations) within the spatial scale of the air monitoring Site for an upper-bound length of time (i.e. longer than an than average length of time that a resident would be expected to reside in one area[8]). Deriving risk/hazard estimates in this manner ensures that any risk management decisions based on these estimates would be protective of individuals who might be exposed to stressors within the spatial scale of either air monitor for a shorter length of time.

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[8] As shown in Table 2 of this Assessment, 26 years is the exposure duration based on the 90th percentile value in Table 16-108 of USEPA (2011). According to Table 16-108, an estimate of the average (arithmetic mean) residential occupancy period is 11.7 years. Thus 11.7 years is an estimate of the average time that a resident could reside near the Station, but this Assessment assumes that the resident is residing for a longer than average time to ensure that the risk/hazard estimates would also be protective of residents who may be residing for less time. Please also see the following link to Table 16-108: https://www.epa.gov/sites/production/files/2015-09/documents/efh-chapter16.pdf#page=195

Section 4.1.5 – Endpoints and Metrics
Endpoints are specific harmful effects that could occur because of being exposed to air toxics in ambient air. This Risk Assessment will not evaluate specific endpoints but will provide quantitative estimates of the cancer risk and noncancer hazard from exposure to COPCs. Cancer risk and noncancer hazard for all COPCs have been estimated using USEPA's RSL Calculator[9], and the cancer risk estimates and hazard quotients are summed to obtain the cumulative cancer risk and hazard index (HI), respectively.

Section 4.2 – Exposure Assessment
To determine the risk and/or hazard for each COPC, an exposure concentration (EC) must be estimated for each HAP. The EC generally can be defined as the "*concentration of a chemical in the air at the point where a person breathes the air*" (USEPA, 2004, pg. 6-17) and is an estimate of the reasonable maximum exposure (i.e., a chronic ambient air concentration of a COPC at the upper end of a distribution of plausible ambient air concentrations that an individual could reasonably be exposed to). Put another way, the EC of a COPC is a high-end exposure estimate of the amount of COPC inhaled within the spatial scale of an air monitoring Site. The EC is estimated as a time-weighted contaminant concentration in air (CA) which considers the frequency, duration, and time of exposure as well as the time over which the exposure is averaged (USEPA, 2009, pg. 13 to 17)[10].

Section 4.2.1 – Estimating the Contaminant Concentration in Air (CA) for a COPC
The CA for a particular COPC is an upper-bound estimate of the chronic (long-term) ambient air concentration of a COPC. A list of all CA's has been provided in Appendix E. The CA is time-weighted to obtain the EC.

To obtain a CA, USEPA (2004) recommends deriving the 95% upper confidence limit of the arithmetic mean (95% UCL) of all valid ambient air sample results collected over 12 months and using the 95% UCL as an estimate of the CA (USEPA, 2004, pg. I-4 and I-5). The 95% UCL is intended to be a "*public health protective estimate of the true annual average*" of all valid ambient air sample results collected over the 12 months since a "*simple arithmetic mean of sampling results may underestimate, approach, or overestimate the true annual average*" (USEPA, 2004, pg. I-4). Even though rotating sampling frequency helps to curb variations due to human activity or traffic patterns, USEPA (2004) indicates that there are still uncertainties to using a simple arithmetic mean to estimate the CA for reasons such as potential inaccuracies with individual measurements and daily variability in concentrations (USEPA, 2004, pg. I-4).

The most current version of EPA's ProUCL (Version 5.1.002) statistical software[11] was used to determine the 95% UCL. The sample results for each COPC, coded either as non-detect or detect (see Section 2.3), were inputted into ProUCL. Based on the size, distribution, and skewness of the sample results comprising the dataset for each COPC, ProUCL recommends an appropriate 95% UCL or indicates that the 95% UCL cannot be derived (USEPA, 2015a, pg. 7). The ProUCL-

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[9] Link to USEPA RSL Calculator: https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
[10] It is important to clarify that the term exposure concentration (EC) is interpreted in USEPA (2004) to be equivalent to the contaminant concentration in air (CA) as defined in this Assessment. This is because USEPA (2004) recommends deriving risk and/or hazard estimates by directly using the CA (as defined in this Assessment). However, the RSL Calculator follows the methodology from USEPA (2009) and uses a time-weighted CA as an estimate of the EC that is subsequently used to derive the final risk and/or hazard estimate.
[11] https://www.epa.gov/land-research/proucl-software

recommended 95% UCL[12] was selected as an estimate of the CA (see exceptions below). All ProUCL inputs and outputs have been included in Appendix F. It is recommended that USEPA (2015a) and USEPA (2015b) be consulted for more information about deriving defensible 95% UCLs.

The dataset for some COPCs were either all non-detect or had less than 4 detects. Since ProUCL guidance indicates that a 95% UCL determined from a dataset with less than 4 detects is not reliable (USEPA, 2015b, pg. 31), the MaxAMDL was used as an estimate of the CA for these COPCs.

Section 4.2.2 – How the Exposure Concentration (EC) is Determined from the CA
As previously mentioned, the EC is a time-weighted CA which considers the frequency, duration, and time of exposure as well as the time over which the exposure is averaged (USEPA, 2009, pg. 13 to 17). However, the EC has not been directly calculated in this Assessment since the risk and/or hazard estimates provided in Appendix H were derived using USEPA's RSL Calculator. According to Section 2.6.1 of the RSL User's Guide, the RSL Calculator derives risk/hazard estimates in accordance with the following equations which only requires the contaminant concentration in air (CA) as the input.

$$\text{Cancer Risk} = (C \times TR) / \text{cancerRSL}$$

$$\text{Noncancer Hazard Quotient (HQ)} = (C \times THQ) / \text{noncancerRSL}$$

Where:

- C = contaminant concentration in air (CA) of the COPC
- TR = 1×10^{-6}
- THQ = 0.1
- cancerRSL = May 2021 USEPA Cancer Resident Air Regional Screening Level (RSL) of the COPC derived at a cancer risk level of 1×10^{-6}.
- noncancerRSL: May 2021 USEPA Noncancer Resident Air Regional Screening Level (RSL) of the COPC derived at a hazard quotient (HQ) of 0.1. The noncancerRSL for Lead is the National Ambient Air Quality Standard of 0.15 $\mu g/m^3$.

The cancerRSLs and noncancerRSLs were derived using the default residential parameters in Table 2. Please see Appendix C for the May 2020 Resident Air RSL table and refer to the RSL User's Guide (USEPA, 2021) for the specific equations used to derive the RSLs. Dividing by the RSL time-weights the CA so that the final risk and/or hazard estimate is based on a residential exposure scenario. Residential exposure parameters are those conservative parameters recommended by EPA for evaluating a resident's risk/hazard from exposure to contaminated environmental media such as air. The estimates provided in Appendix H represent the risk/hazard associated with resident RME to COPCs[13]. Deriving risk/hazard estimates based on a residential scenario ensures that risk management decisions based on these estimates would also be protective

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[12] In some cases, ProUCL recommends a 99% UCL over a 95% UCL. In these cases, the 99% UCL was selected to be consistent with the ProUCL recommended value.
[13] For COPCs with datasets with less than 4 detects, the MaxAMDL was used as an estimate of the CA. For the purposes of this Assessment, the MaxAMDL is assumed to be a high-end exposure estimate.

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of others (visitors, workers, etc.) who would be expected to have a lower exposure to COPCs present in ambient air within the spatial scale of each Site.

Table 2: Default Residential Parameters used in the RSL Calculator to Determine the Exposure Concentration (EC)

ED	Exposure duration	26 years	26 years is a default exposure duration value used in the residential exposure scenario. The value is obtained from Table 16-108; 90th percentile for current residence time in USEPA (2011). 26 years is a conservative assumption for the total length of time an individual resident could inhale ambient air chemicals within the spatial scale of an air monitoring Site.
EF	Exposure frequency	350 days/year	This value is from page 15 of USEPA (1991) and is a residential exposure frequency. Though 365 days/year (every day per year) is a more conservative exposure frequency, USEPA believes that "*the common assumption that workers take two weeks of vacation per year can be used to support a value of 15 days per year spent away from home (i.e., 350 days/year spent at home)*" (USEPA, 1991, pg. 5). 350 days/year is still a conservative EF, but better represents RME conditions.
ET	Exposure time	24 hours/day	A resident is assumed to be able to be exposed to environmental chemicals for a maximum of 24 hours a day (USEPA, 1989a, pg. 6-6). 24 hours/day is the maximum amount of time per day that an individual could inhale an air toxic within the spatial scale of an air monitoring Site. Thus, this exposure factor is conservative.
LT	Lifetime	70 years	70 years is a standard assumption used by USEPA (USEPA, 1989a, pg. 6-22) to represent a hypothetical individual's lifetime and is the length of time over which exposure to a carcinogenic HAP is prorated. This assumes that exposure to a higher amount of carcinogen over a short period of time is equivalent to exposure to a corresponding lower concentration of carcinogen spread out over a lifetime (USEPA, 2005a, pg. 3-26).

Section 4.3 – Toxicity Assessment

The purpose of the toxicity assessment is to identify the cancer and noncancer effects of a chemical [hazard identification] and to quantify its toxicity [dose-response assessment] (USEPA, 2004, pg. 12-1). For many of the chemicals, toxicity assessments have already been conducted by toxicologists either at USEPA or another Federal/State agency. Thus, the focus of this section is to briefly explain the toxicity values that are used to derive risk/hazard estimates.

Section 4.3.1 – Toxicity Values
During the toxicity assessment, the information from the hazard identification and dose-response assessment are translated into specific toxicity values. Two kinds of toxicity values are used in the to evaluate inhalation: the reference concentration (RfC) and the inhalation unit risk (IUR).

The RfC "*is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncarcinogenic health effects during a lifetime*" (USEPA, 1994, pg. 1-2 to 1-4). Please consult USEPA (1994) and a chemical's noncancer toxicity assessment for more information on how a RfC is derived.

The IUR is defined as "*the upper-bound excess lifetime carcinogenic risk estimated to result from continuous exposure to an agent at a concentration of 1 μg/m^3 in air*" (USEPA, 2009, pg. 10). Please consult USEPA (2005a) and a chemical's cancer toxicity assessment for more information on how an IUR is derived.

Appendix G lists the toxicity values for all COPCs. Since the purpose of this Assessment is to assess long-term (chronic) exposure to ambient air, only chronic toxicity values have been used. IURs were used in deriving the cancerRSL while RfCs were used in deriving the noncancerRSL. As explained in Section 4.2.2, the toxicity values were not directly used to produce the risk/hazard estimates; cancer risk was derived by dividing by the cancerRSL while the hazard quotient (HQ) was derived by dividing by the noncancerRSL.

Section 4.3.2 – USEPA Human Health Toxicity Values Hierarchy
Many different State and Federal organizations publish toxicity values. For some air toxics, one organization may have published an IUR while another organization may have published an RfC, and it is necessary to organize the sources from which toxicity values are selected so that the toxicity values used to assess a particular air toxic are determined using a consistent procedure.

EPA's OAQPS has a published list of chronic toxicity values that it recommends for use in air risk assessment[14] which prioritizes using EPA Integrated Risk Information System (IRIS) toxicity values whenever they are available[15]. However, OAQPS does not consider USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs), which are derived for USEPA's Superfund program and are not considered USEPA consensus values. To ensure that all technically defensible toxicity values available for air toxics are being considered, including the PPRTVs which are derived by EPA scientists and are both internally and externally peer-reviewed[16], this Assessment deviates from the OAQPS hierarchy and has selected the toxicity values in Appendix G following USEPA's Human Health Toxicity Values Hierarchy recommended for Superfund risk assessments, summarized below (USEPA, 2003):

- Tier 1 toxicity values: USEPA's Integrated Risk Information System (IRIS), found at: https://www.epa.gov/iris, is consulted first. USEPA considers IRIS to be its preferred

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[14] https://www.epa.gov/fera/dose-response-assessment-assessing-health-risks-associated-exposure-hazardous-air-pollutants
[15] https://www.epa.gov/fera/prioritization-data-sources-chronic-exposure
[16] https://www.epa.gov/pprtv/basic-information-about-provisional-peer-reviewed-toxicity-values-pprtvs#basicinfo

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source for toxicity information on air toxics and "*IRIS health assessments contain [USEPA] consensus toxicity values*" (USEPA, 2003, pg. 2).

- Tier 2 toxicity values: If a chemical does not have a toxicity value listed in IRIS, USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) are consulted next. USEPA PPRTVs are developed by USEPA's Office of Research and Development Center for Public Health and Environmental Assessment and USEPA's Human Health Risk Assessment National Research Program. These values are peer-reviewed, but are developed primarily for use in EPA's Superfund program and not necessarily considered a consensus toxicity value within USEPA. For more information on PPRTVs, please refer to: https://www.epa.gov/pprtv/basic-information-about-provisional-peer-reviewed-toxicity-values-pprtvs.

- Tier 3 toxicity values: If a chemical does not have a PPRTV (or an IRIS toxicity value), then toxicity values from other sources may be used. Though USEPA's Toxicity Values Hierarchy does not have clear criteria to prioritize which Tier 3 toxicity values should be considered first, USEPA generally recommends that Tier 3 values be obtained from "*sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed*" (USEPA, 2003, pg. 3). The RSL User's Guide defines a hierarchy for Tier 3 toxicity values in Section 2.3 of USEPA (2021). The hierarchy is described below:

  o EPA's Office of Pesticide Programs (OPP) Human Health Benchmarks for Pesticides were considered if a Tier 1 or Tier 2 toxicity value is not available.

  o If an OPP benchmark was not available, then chronic inhalation minimal risk levels (MRLs) from the Agency for Toxic Substances and Disease Registry (ATSDR), found at https://www.atsdr.cdc.gov/mrls/mrllist.asp[17], are selected. For the purposes of the HHRA, MRLs are considered equivalent to RfCs.

  o If an MRL is not available, chronic RfCs published by the California Environmental Protection Agency Office of Environmental Health Hazard Assessment (CalEPA) were used. If an IUR was not available from a Tier 1 or 2 source, then the IUR published by CalEPA was used. CalEPA toxicity values can be found here: https://oehha.ca.gov/chemicals.

  o For some chemicals, the toxicity assessments used to obtain a PPRTV ("PPRTV Assessments") also contain "screening" toxicity values which although published are considered to have more uncertainty in their derivation than a PPRTV. These are used for chemicals when an MRL or CalEPA toxicity value is not available.

  o If a chemical does not have a toxicity value in the Tier 3 sources, then toxicity values listed in the USEPA Superfund program's Health Effects Assessment Summary Table (HEAST), found at https://epa-heast.ornl.gov/ were used.

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[17] Only the chronic inhalation MRLs are obtained from ATSDR.

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Section 4.3.3 – COPCs that Act Through a Mutagenic Mode of Action

Benzo(a)pyrene and Ethylene Oxide are two COPCs that have been accepted to act through a mutagenic mode of action (MMOA)[18] and a hypothetical resident could potentially have an increased susceptibility to cancer from exposure to these carcinogens earlier in life (starting from birth up to age 16) relative to exposure later in life (USEPA, 2005b, pg. 30-33; USEPA, 2021, Section 5.17). To ensure that the cancer risk estimates presented in Appendix H are reflective of the MMOA of these COPCs, the cancerRSLs used to derive the risk estimate were derived using a modified equation which incorporates default age-dependent adjustment factors (USEPA, 2005b, pg. 37; USEPA, 2021, Section 4.1.3.3).

Section 4.3.4 – Toxicity Values Unavailable

Benzaldehyde was selected as a COPC in the PRBSA due to the MDC exceeding the State of Michigan ITSL. However, Benzaldehyde does not have toxicity values in either a Tier 1, Tier 2, or Tier 3 source. Thus, the COPC risk/hazard estimates provided in Appendix H are not reflective of Benzaldehyde. Please see Section 5 for a further discussion on the uncertainties surrounding the use of State of Michigan ITSLs/IRSLs.

Section 4.3.5 – Using RPFs to Determine IUR for Select PAHs

The IUR for several polycyclic aromatic hydrocarbons (PAHs) listed in Appendix G were derived by adjusting the IUR of Benzo(a)pyrene with chemical-specific relative potency factors (RPF). Frequent Question #46 in USEPA (2021) provides a detailed justification and reasoning behind why this is done.

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[18] In the HHRA, Chromium was assessed as Hexavalent Chromium (and was selected as a COPC based on the Hexavalent Chromium cancerRSL). Hexavalent Chromium is accepted to act through a mutagenic mode of action (MMOA). However, please see Section 5 for more information.

Section 4.4 – Risk Characterization

In the risk characterization step, the information from the exposure assessment and the toxicity assessment are integrated to obtain a cancer risk and/or hazard quotient (HQ) for each COPC as well as a cumulative cancer risk and hazard index (HI). USEPA's RSL calculator was used to obtain these estimates as explained in Section 4.2.2.

Section 4.4.1 – Risk and/or Hazard Estimates for COPCs

The cumulative cancer risk and hazard index (HI) determined at each monitoring Site has been summarized below. The Risk/Hazard tables for the individual COPCs at NR-285 and South DeKalb can be found in Appendix H while the supporting RSL Calculator outputs can be found in Appendix I.

The cumulative cancer risk and hazard index (HI) was determined by summing the cancer risk of individual COPCs, which assumes response addition, and summing the HQs, which assumes concentration addition (USEPA, 2000, pg. 76, 125; USEPA, 2004, pg. 13-6, 13-9). Please see Section 5 of this Risk Assessment for more discussion on response and concentration addition. As recommended by EPA, the cumulative cancer risk and HI that have been determined in this Assessment have been reported to 1 significant figure (USEPA, 2004, pg. 13-7).

Monitoring Site	Cumulative Cancer Risk	Hazard Index (HI)
South DeKalb	2E-03	20
South DeKalb (cumulative cancer risk not including Ethylene Oxide)	1E-04	
NR-285 VOCs	1E-04	20

Except for Ethylene Oxide, the cancer risks for individual COPCs at both South DeKalb and NR-285 are within USEPA's and EPD Air Protection Branch acceptable cancer risk range of $1x10^{-4}$ to $1x10^{-6}$ (USEPA, 1989b). The cumulative cancer risk at South DeKalb is outside of the cancer risk range due to the individual cancer risk of Ethylene Oxide exceeding $1x10^{-4}$, the higher end of the acceptable cancer risk range.

Except for Acrolein, the hazard quotients for the individual COPCs do not exceed 1. The hazard index determined at each air monitoring Site exceeds 1, indicating a potential for adverse noncancer effects. However, the results suggest that Acrolein is the primary contributor to the hazard index.

Since the monitoring Sites do not necessarily have the same COPCs, the cumulative cancer risk or HI determined at one monitoring Site should not be compared with those determined at other monitoring Sites. It is also important that the risk/hazard estimates provided in this Section be interpreted considering the uncertainties described in Section 5.

Section 4.5 – Limitations of the HHRA

There are limitations as to the information that can be obtained from the risk/hazard estimates that have been provided. It is important to understand that these risk/hazard estimates:

- Only estimate risk/hazard for COPCs with toxicity values, meaning that any air toxic that was a COPC but which does not have toxicity values cannot be assessed quantitatively. In this Assessment, Benzaldehyde is the only COPC that could not be quantitatively evaluated in the HHRA.
- The estimates are representative of risk/hazard to a hypothetical individual residing for a longer than average period within the spatial scale of each air monitoring Site and inhaling a greater than average concentration of air toxics. This ensures that a risk management decision would be protective of individuals who may be exposed to lower concentrations of ambient air for a much less long period of time.
- The estimates do not include potential risks/hazards from inhaling chemicals that were not analyzed. The risk/hazard estimates at NR-285 are only representative of VOC COPCs.
- The estimates do not necessarily represent the risk/hazard to a specific individual.
- The estimates **cannot** determine if an individual diagnosed with cancer or a noncarcinogenic disorder developed illness due to inhaling ambient air within the spatial scale of any of the monitoring Sites.
- The estimates cannot be used to estimate potential risks/hazards at any other location (e.g. the risk/hazard estimates developed for South DeKalb cannot estimate risks/hazards to residents in Augusta, GA who may inhale ambient air).
- The estimates do not represent risks/hazards from generally inhaling air toxics in ambient air.
- The estimates cannot pinpoint the sources of the chemicals present in ambient air, which are "*a combination of background concentrations and the same chemical released from possibly multiple sources*" (USEPA, 2004, pg. 10-37).

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Section 5 – Uncertainty Section

An integral part of any risk assessment is the uncertainty section, where "*major uncertainties associated with determining the nature and extent of the risk are identified and discussed*" (USEPA, 2004, pg. 13-1). Uncertainties are inherent to all risk assessments due to the procedures used to obtain risk/hazard estimates. The purpose of this section is to discuss specific uncertainties so that the results of the Assessment can be properly understood and utilized.

Section 5.1 – Dataset Gaps

Since the Assessment is based on the useable sample values for 78 air toxics at South DeKalb and 43 VOCs at NR-285, it is unknown how the cumulative cancer risk or hazard index determined at each monitoring Site would be affected if there was available monitoring data for additional air toxics and if more sample values were useable.

Section 5.2 – COPC Selection Uncertainty and use of State of Michigan ITSLs/IRSLs

The use of cancerRSLs and/or noncancerRSLs in the PRBSA for screening is a conservative and EPA accepted methodology (USEPA, 2018, pg. 2-7) to focus the HHRA on only the COPCs, those air toxics which could reasonably pose an unacceptable risk/hazard and may need to be addressed by risk managers. However, several of the air toxics evaluated in this Assessment do not have RSLs and were either screened in/out using surrogate RSLs or State of Michigan ITSLs/IRSLs.

There is always an inherent uncertainty in the use of surrogate RSLs since they may not be adequately representative. In this Assessment, justification for the use of a particular surrogate RSL have been provided where applicable on the COPC Selection Tables and every effort has been made to ensure that the surrogate RSL used is technically defensible. Though risk/hazard could be underestimated for air toxics that screened out using surrogate RSLs, it is clear from the risk results that the use of a Hexavalent Chromium cancerRSL to conservatively screen in Chromium for assessment in the HHRA resulted in an overestimation of the Chromium cancer risk since AAMP has indicated that the ambient air Chromium was determined to be 100% Trivalent Chromium (see Section 5.7).

Several air toxics without RSLs were screened using State of Michigan ITSLs/IRSLs. Out of these air toxics, only Benzaldehyde was selected as a COPC. None of these air toxics have toxicity values; and thus, a quantitative evaluation of these specific air toxics in the HHRA is not possible. The ITSLs/IRSLs, for which the technical basis has been explained (and provided in Appendix C) and have been accepted for use in the State of Michigan, were used in the PRBSA to provide a limited evaluation to determine whether these air toxics could be of concern. It appears that out of these air toxics, only Benzaldehyde potentially could be of concern even though a quantitative risk/hazard estimate for Benzaldehyde cannot be provided in the HHRA. Based on recommendations in EPA guidance, an explanation into possible health effects of all air toxics without toxicity values has been provided in Appendix G.

Section 5.3 – Representativeness
Though GAEPD (2020) provides the accepted spatial scale of each air monitoring Site, ambient air monitoring really "*only provides estimates of concentrations at the point at which samples are taken, and it is often difficult to clearly define the spatial coverage that those measured concentrations represent*" (USEPA, 2004, pg. 10-7). As mentioned in GAEPD (2020), ambient air concentrations are assumed to be uniform within the spatial scale of an air monitoring Site. Risk/hazard for each COPC was determined in this Assessment from a high-end exposure estimate of the COPC assumed to be uniform throughout the spatial scale. Realistically, the ambient air concentration of an air toxic can vary even within the spatial scale of an air monitoring Site due to various factors, including:

- meteorological factors, such as wind speed and direction and ambient air temperature
- physical factors, such as buildings/structures or variability in terrain elevation
- chemical transformation of chemicals which may attenuate or increase the concentrations of toxic air pollutants

Section 5.4 – Only Inhalation Exposure Route is Assessed
Since only ambient air monitoring data is available, only the inhalation exposure route has been assessed in the HHRA. As previously mentioned, it is possible for air toxics to deposit onto soil, water bodies, and other surfaces and for individuals to encounter these chemicals. There could be risks/hazards associated with other routes of exposure that are not quantifiable in this Assessment.

Section 5.5 – Air Toxics without Toxicity Values
At each monitoring Site, there were several air toxics which do not have toxicity values from a Tier 1-3 source. Though State of Michigan ITSLs/IRSLs resulted in only Benzaldehyde being selected as a COPC out of these air toxics, there is no way to quantify whether these air toxics could present an unacceptable human health risk/hazard. The cumulative risks and hazard indices provided in this Assessment could be underestimated due to not being able to assess these air toxics.

EPA guidance recommends that if a toxicity value is not available for an air toxic, the risk assessor "s*hould describe the effects of the chemical qualitatively and discuss the implications of the absence of the chemical from the risk estimate in the uncertainty section of the risk assessment*" (USEPA, 2004, pg. 12-31). The general implication for not including air toxics without toxicity values have been discussed above, while qualitative descriptions of the health effects of COPCs without toxicity values have been provided in Appendix G.

Section 5.6 – Response and Concentration Addition
The cumulative cancer risk is derived assuming that the individual COPC cancer risks can be added since it is presumed that each carcinogenic COPC acts toxicologically independent of the other at low exposure levels (relative to exposure levels measured in scientific studies) so that the body's response to a particular COPC is not influenced by exposure to the other COPCs (USEPA, 2000a, pg. 12, 71, 119). Termed response addition, this process of aggregating the cancer risk estimates of individual carcinogens has been established in EPA guidance as a method to obtain a cumulative cancer risk estimate that is not "*overly conservative*" (USEPA, 2000a, pg. 125; USEPA, 2004, pg.

13-6). Toxicological interactions between multiple carcinogens may result in greater or lesser risk for cancer than suggested by the cumulative cancer risk estimate (USEPA, 2000, pg. 127). One study cited by EPA determined that response addition produces an "*improbable, but not misleading*" estimate of cumulative cancer risk as the number of chemicals whose risks are summed together increase (USEPA, 2000, pg. 126). However, given EPA's general acceptance and use of response addition and the lack of detailed, definitive information on possible chemical interactions between air toxics measured at each of the air monitoring Sites, the cumulative cancer risks provided in this Risk Assessment could be considered to provide an upper-bound risk estimate which can assist in making a risk management decision considering the various uncertainties.

Based on concentration addition, the HIs presented in this Assessment are derived by summing the HQs determined for individual noncarcinogenic COPCs. (USEPA, 2004, pg. 13-9). This assumes that each noncancer COPC behaves the same (same/similar toxicokinetics) and induces the same/similar toxicological effects, which EPA has determined can be relaxed to acting on the same target organ (USEPA, 2000, pg. 28, 80). The results of the Assessment suggest that the Acrolein HQ of 20 (at 1 significant figure) determined at each Site is the primary contributor to the HIs.

Section 5.7 – Chromium
AAMP indicated that Chromium analyzed at South DeKalb is 100% in the Trivalent form (Cr^{3+}). Since Cr^{3+} does not have available inhalation toxicity values, Chromium was evaluated in this Assessment using Hexavalent Chromium (Cr^{6+}), which has both an RfC and IUR, as a surrogate. This practice, which assumes that Chromium is 100% in the Hexavalent form, determined a cancer risk of 1E-04 and noncancer HQ of 0.01. The cancer risk is within the acceptable cancer risk range and the noncancer HQ is below 1. Based on studies which suggest that "*chromium(III) compounds appear to be less toxic than chromium(VI) compounds*" (ATSDR, 2012, pg. 23, 233, 315), the evaluation of Chromium as Hexavalent Chromium in this Assessment is probably conservative. Since even this conservative assessment of Chromium suggests that the cancer risk is within the acceptable risk range and that adverse noncancer effects are not likely to occur, Chromium concentrations in ambient air are not expected to pose a concern.

Section 5.8 – Ethylene Oxide
At South DeKalb, the cumulative cancer risk (2E-03) was found to be outside of the acceptable cancer risk range due to the presence of Ethylene Oxide, which AAMP began analyzing for at South DeKalb starting January 2020 (GAEPD, 2020, pg. 24). Without Ethylene Oxide (which has an individual cancer risk of 2E-03), the cumulative cancer risk at South DeKalb is within the acceptable cancer risk range.

Examples of industries which may release Ethylene Oxide into the air are cellulose product manufacturers and commercial sterilization facilities (USEPA, 2004, pg. E-7, E-8). There are also "background" concentrations of Ethylene Oxide, defined by EPA in an explainer document last updated in October 2021[19] as "*ethylene oxide in the outdoor air that is not clearly linked to a*

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[19] For a link to this document, please see: https://www.epa.gov/hazardous-air-pollutants-ethylene-oxide/epas-work-understand-background-levels-ethylene-oxide.

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particular industrial facility, such as a chemical plant or commercial sterilizer". Thus, the Ethylene Oxide concentrations detected at South DeKalb are considered "background" concentrations since there are no known sources of Ethylene Oxide near South DeKalb (GAEPD, 2021, pg. 15). The EPA document goes on to explain that an inability to detect Ethylene Oxide at all levels and high-biased results due to the canisters used to sample ambient air contribute to the inability to "*put an exact number*" on Ethylene Oxide background levels in ambient air[19]. Though a quantitative risk estimate was provided for Ethylene Oxide due to the availability of an IUR from IRIS, the EPA explainer document unequivocally states that "*we do not have enough confidence in monitoring measurements of background ethylene oxide to use them to estimate risk*"[19]. Thus, the risk estimates provided for Ethylene Oxide should be interpreted with caution. AAMP is currently working with other State and Federal partners on an Ethylene Oxide air monitoring study to better understand the impact of Ethylene Oxide in ambient air in Georgia (GAEPD, 2021).

Section 5.9 – Assessing Acrolein using the MaxAMDL
The HQ for Acrolein is 20 (at one significant figure) is based on using the MaxAMDL as the CA. Acrolein is the primary contributor to the HI at both monitoring Sites. However, the sample results show that Acrolein was detected in only 1 sample at South DeKalb and in none of the samples at NR-285. The MaxAMDL was used as an estimate of the CA when deriving risk/hazard estimates since there was not enough detects to derive a 95% UCL.

An RfC of 0.00002 (2E-05) mg/m^3 (0.02 µg/m^3) was used in deriving the Acrolein noncancerRSL ultimately used to derive the Acrolein HQ. This RfC is an IRIS value last updated in 2003. It is recognized that EPA's OAQPS does not recommend the use of the Acrolein IRIS RfC for air risk assessments and instead recommends using an RfC of 0.00035 (3.5E-04) mg/m^3 (0.35 µg/m^3) and indicates that this RfC is an "*inhalation reference exposure level finalized by CalEPA in 2008, providing the most recent peer-reviewed assessment based on the most recent data*"[20]. Using the OAQPS recommended RfC and the MaxAMDL as an estimate of the CA results in a HQ of 1, suggesting that adverse noncancer effects from Acrolein would not be likely to occur (please see Appendix I for the RSL Calculator output). However, since the IRIS RfC has not been retracted by EPA, it was used in the HHRA to be consistent with the toxicity values hierarchy (USEPA, 2003) and avoid the appearance of "picking-and-choosing" less conservative toxicity values. Given the uncertainty as to the appropriate RfC for Acrolein and since the Acrolein HQs are not based off a 95% UCL, the Acrolein HQs derived at both Sites should be interpreted with caution.

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[20] Please see: https://www.epa.gov/system/files/documents/2021-09/chronicfinaloutput_9_29_2021-12-46-18-pm_0.pdf and https://www.epa.gov/fera/additional-information-adjustments-and-special-cases-dose-response-values-tables-1-and-2

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Section 6 – Conclusion

This Assessment was prepared and is consistent with relevant, publicly available USEPA risk assessment guidance and has strived to faithfully represent the validated air monitoring results from each monitoring Site while providing risk/hazard estimates that are derived in a defensible manner. The risk/hazard estimates derived in the HHRA represent a hypothetical individual residing within the spatial scale of each air monitoring Site for a longer than average length of time and who would be exposed to air toxics concentrations at the upper range of plausible air toxics concentrations. The purpose behind deriving risk/hazard estimates in this manner is to be consistent with EPA guidance and to ensure that any risk management decision made based on these estimates would be protective of individuals who may be exposed to lower concentrations of air toxics within the spatial scale of each air monitoring Site.

Except for Ethylene Oxide, the cumulative cancer risk for all other air toxic COPCs fall within the EPA and EPD Air Protection Branch acceptable cancer risk range of 1×10^{-4} to 1×10^{-6} (USEPA, 1989b). The HIs at both monitoring Sites exceed 1, but the air toxic Acrolein is the primary contributor to the HI being elevated.

There are a lot of uncertainties involving the dataset and the parameters selected to prepare the Assessment and those uncertainties should be kept in mind when interpreting the findings. The uncertainties in the analysis of Ethylene Oxide and Acrolein have been explained in Section 5 and should be considered when interpreting the risk/hazard estimates provided in the HHRA. The other major uncertainties have been discussed in Section 5. Even then, this Assessment is best suited for determining which air toxics are not expected to be a concern (acceptable risk/hazard) and for identifying where further information may need to be collected to make an appropriate risk management decision (USEPA, 2004, pg. 13-4). Additionally, this Assessment will need to be evaluated in context with other pieces of information (regulatory policies, social values, economics, etc.) when making a risk management decision(s) and should not be the sole driver for making decisions on how to reduce concentrations of air toxics to human health protective levels.

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