MID-OHIO REGIONAL
MORPC
PLANNING COMMISSION

CENTRAL OHIO AIR QUALITY END OF SEASON REPORT 2020

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CENTRAL OHIO END OF SEASON REPORT

NOVEMBER 2019 – OCTOBER 2020

The Mid-Ohio Regional Planning Commission (MORPC), part of a network of agencies across the country, issues daily air quality forecasts and notifies the public when ozone and particle pollution levels are considered to be unhealthy for sensitive groups of people.

MORPC provides forecasts for two main air pollutants that are a threat to public health in Central Ohio: ground-level ozone pollution and particle pollution ($PM_{2.5}$). Central Ohio is currently attaining the National Ambient Air Quality Standards for both ozone and particle pollution. Ozone pollution is more common on hot summer days and is monitored from March through October. Particle pollution can occur year-round and usually peaks overnight. High concentrations of ground-level ozone or particle pollution in the air can affect us all, especially sensitive groups of people.

MORPC works with Sonoma Technology, Inc. (STI) to deliver year-round daily air quality forecasts and Air Quality Alerts. This report provides an analysis of the 2019 – 2020 season.

HIGHEST AQI DAYS
WITH PEAK MONITOR LOCATION

- **101 OZONE | JULY 6, 9**
  MAPLE CANYON DR. & DELAWARE
- **100 OZONE | JULY 8**
  MAPLE CANON DR.
- **93 OZONE | JUNE 21, AUGUST 9**
  NEW ALBANY
- **90 OZONE | JULY 17**
  NEW ALBANY

SUMMARY

- The number of days with Good air pollution levels — based on the Air Quality Index seen below and explained on the next page — increased slightly to 83% for ozone pollution and 94% for particle pollution in 2019 – 2020, up from 78% and 89%, respectively, in 2018 – 2019. This trend is associated with above-average precipitation in Ohio over the past year. Overall, the percentage of Good AQI days has remained fairly steady over the past three years for both ozone and $PM_{2.5}$.
- Two days with air pollution levels that were Unhealthy for Sensitive Groups were observed during the year, both occurring in July. Ozone was the main pollutant. There were no Unhealthy for Sensitive Groups days for particle pollution.
- Over the past 28 years, the number of days with high ozone pollution (above 70 parts per billion for the daily maximum 8-hour average) has generally declined in Central Ohio, driven mostly by emissions reductions. However, there are some variations from year to year due to weather conditions.
- Unlike in recent years, significant wildfire smoke was not transported into the Columbus area from other regions. This led to a majority of days with Good levels of particle pollution.

AIR QUALITY INDEX (AQI VALUES)	0 - 50	51 - 100	101 - 150	151 - 200	201 - 300
LEVELS OF HEALTH CONCERN	GOOD	MODERATE	UNHEALTHY FOR SENSITIVE GROUPS	UNHEALTHY	VERY UNHEALTHY

AIR POLLUTION OVERVIEW

OZONE POLLUTION

MORPC monitors and sends out forecasts and alerts for ground-level ozone pollution levels from March through October. Ground-level ozone pollution is created when emissions from sources such as cars, industry, and lawn equipment react chemically in the presence of sunshine. Concentrations of ground-level ozone peak when temperatures are warm, it is sunny, and winds are light. Ozone is the main ingredient of smog.

PARTICLE POLLUTION

MORPC monitors and sends out forecasts and alerts for particle pollution levels year-round. Fine particle pollution ($PM_{2.5}$) is made of microscopically small solid or liquid particles. Some sources of these fine particles are diesel trucks, buses, power plants, and wood burning fireplaces. Concentrations of $PM_{2.5}$ often peak during overnight hours when cool air is trapped near the ground and pollution levels build in that layer of air. Particle pollution can also be transported into Central Ohio over large distances, such as from distant wildfires, depending on weather conditions.

AIR QUALITY INDEX

The Mid-Ohio Regional Planning Commission issues daily forecasts and Air Quality Alerts to keep the public informed of local air pollution levels. MORPC uses the Air Quality Index to report pollution levels. The higher the AQI level, the greater the health concern. When air pollution is expected to reach 101 AQI or above, MORPC issues an Air Quality Alert for Central Ohio.

AIR QUALITY INDEX (AQI VALUES)	HEALTH ADVISORY
GOOD 0 - 50	None.
MODERATE 51 - 100	Unusually sensitive people should consider reducing prolonged or heavy exertion.
UNHEALTHY FOR SENSITIVE GROUPS 101 - 150	People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.
UNHEALTHY 151 - 200	People with heart or lung disease, older adults and children should reduce prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.
VERY UNHEALTHY 151 - 200	People with heart or lung disease, older adults and children should reduce prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.

CENTRAL OHIO OZONE AND $PM_{2.5}$ MONITOR LOCATIONS

The Ohio EPA maintains the Ohio air monitoring network as part of its responsibility to regulate air quality to protect public health and the environment in the state of Ohio. The most recent map with locations of Central Ohio monitoring sites for ozone and particle pollution is shown in the map below.

IDENTIFIER	MONITOR	POLLUTANT
1	Delaware	Ozone
2	Centerburg	Ozone
3	Maple Canyon	Ozone, $PM_{2.5}$
4	New Albany	Ozone, $PM_{2.5}$
5	Heath	Ozone
6	Fairgrounds	$PM_{2.5}$
7	Reynoldsburg	Ozone
8	London	Ozone

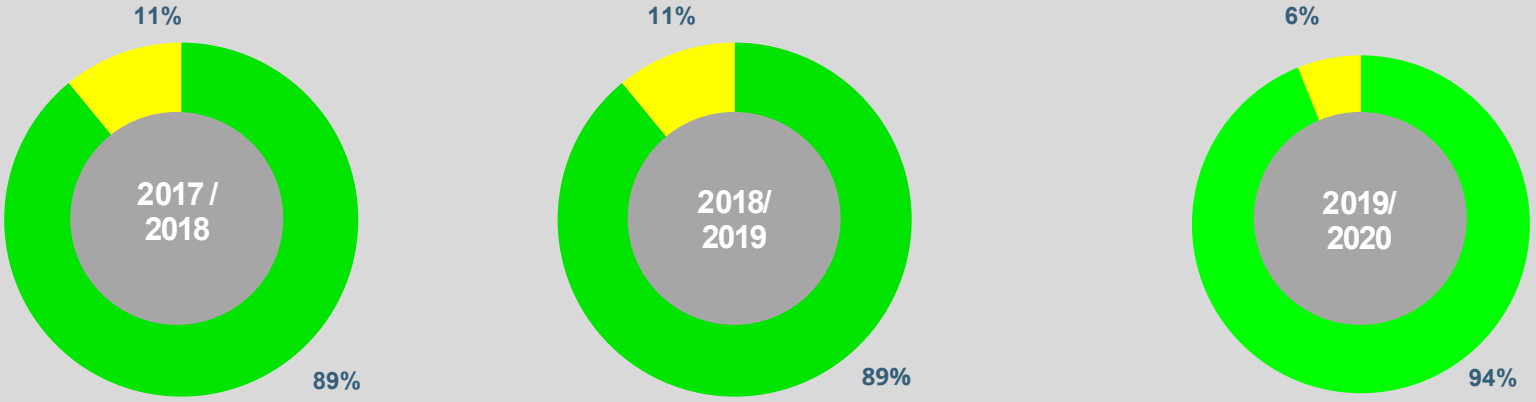
CENTRAL OHIO END OF SEASON REPORT: NOV. 2019 – OCT. 2020

Particle pollution levels did not reach the Unhealthy for Sensitive Groups (USG) AQI category in Central Ohio during the 2019 – 2020 season (top row in figure below). During this season, air quality for $PM_{2.5}$ was in the Good category of the Air Quality Index (AQI) on 94% of days and in the Moderate AQI category on only 6% of days.

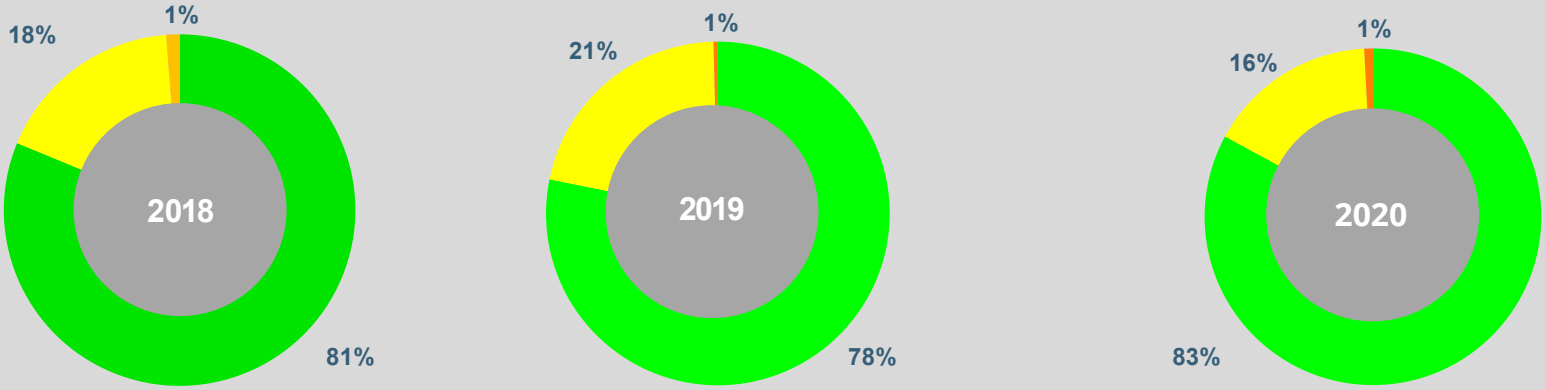
Ozone AQI levels reached the USG AQI category on two days in the Columbus region during the 2020 summer season. Air quality for ozone was in the Good category of the AQI on 83% of days and in the Moderate AQI category on 16% of days.

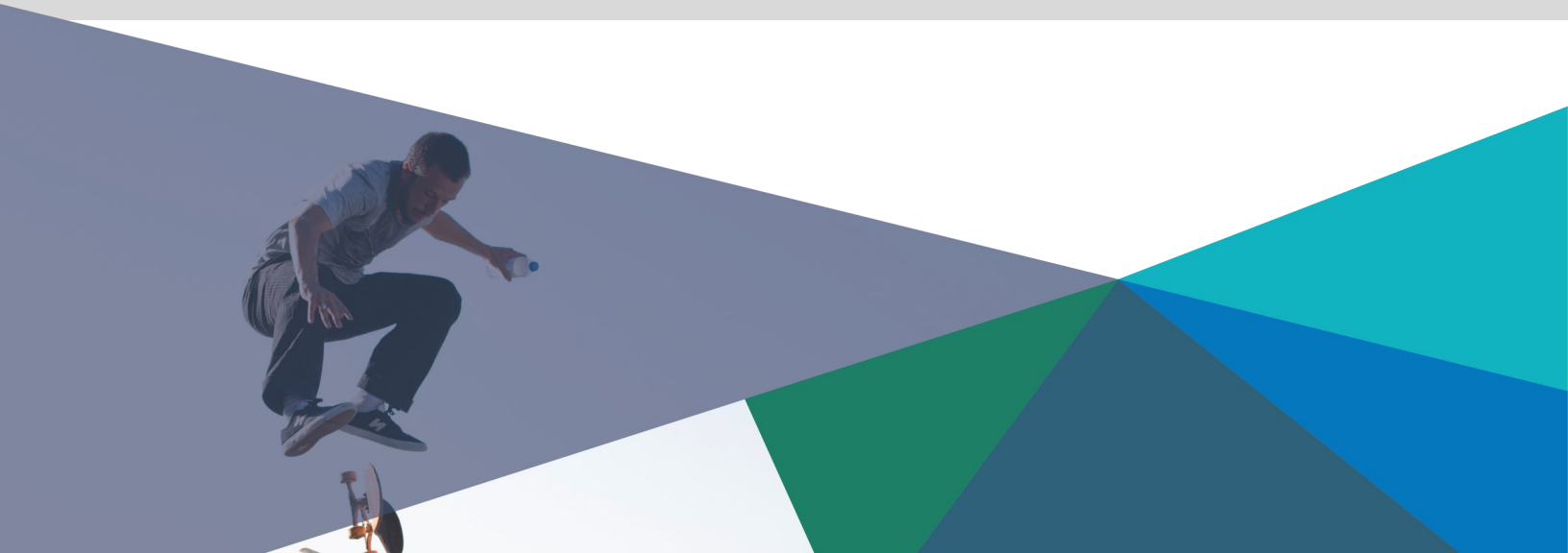
Overall, the percentage of Good AQI days has remained fairly steady over the last three years for both ozone and $PM_{2.5}$.

PERCENTAGE OF DAYS AT EACH AQI CATEGORY: $PM_{2.5}$ (NOVEMBER – OCTOBER)



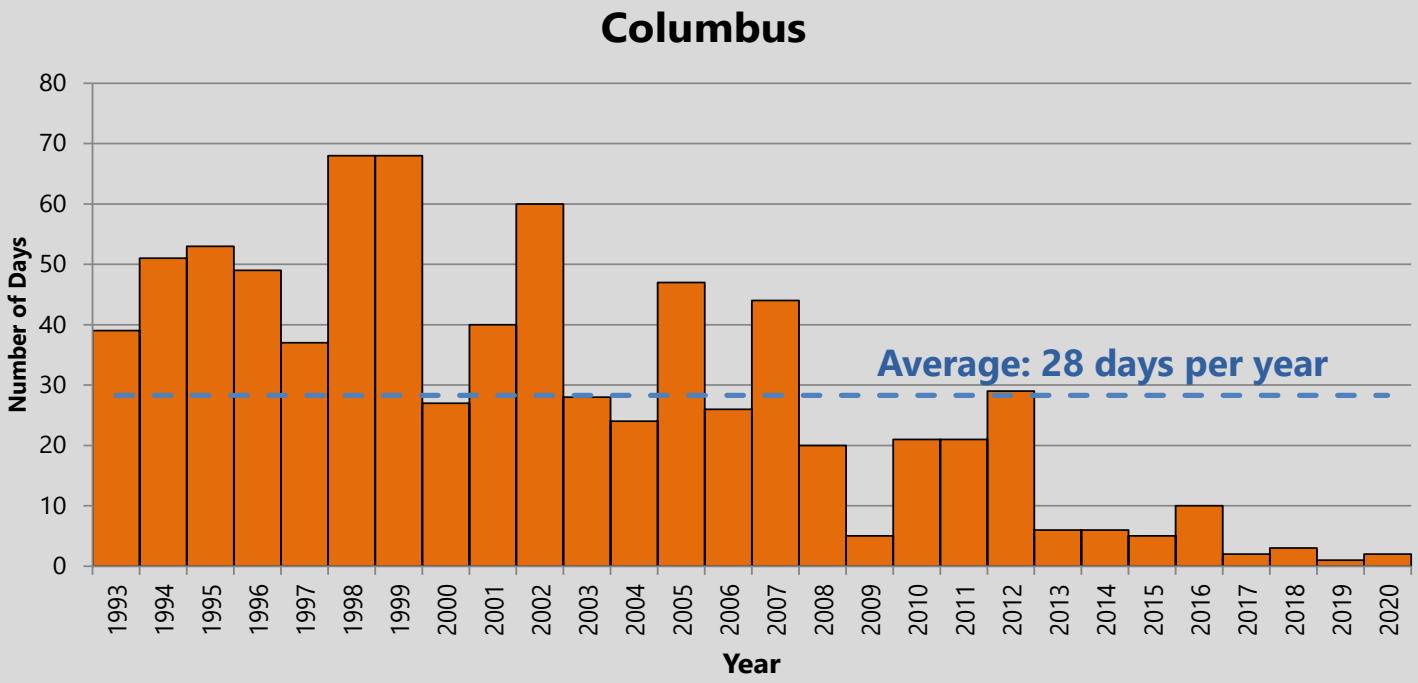
PERCENTAGE OF DAYS AT EACH AQI CATEGORY: SUMMERTIME OZONE (MARCH – OCTOBER)

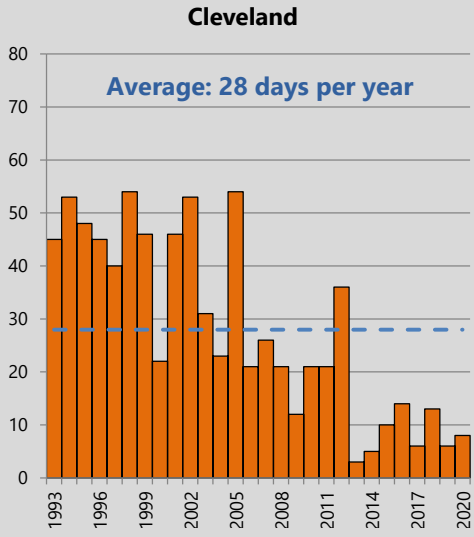


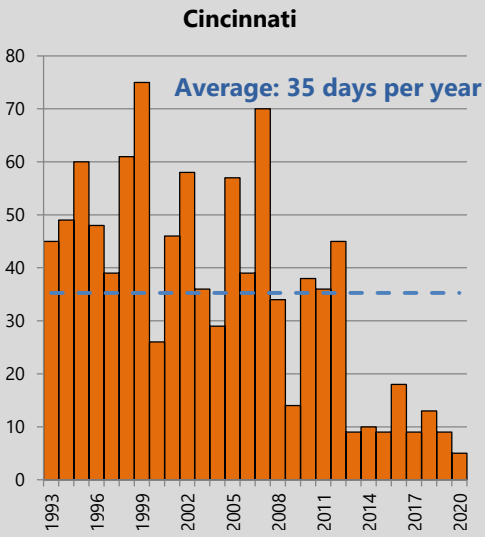


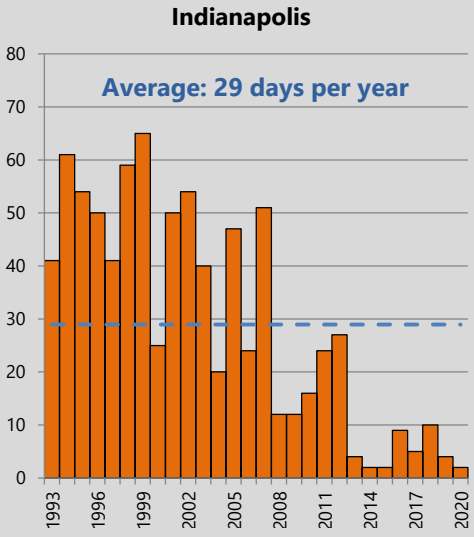
REGIONAL COUNTS OF HIGH OZONE DAYS

Over the past 28 years, the number of high ozone days when pollution levels exceed the national standard has gone down in Central Ohio, caused mostly by emissions reductions. However, there are differences from year to year caused by weather conditions. The charts below indicate the number of high ozone days each year (orange bars) for several major cities throughout the region. The long-term (28 year) averages are indicated with the dashed blue line.









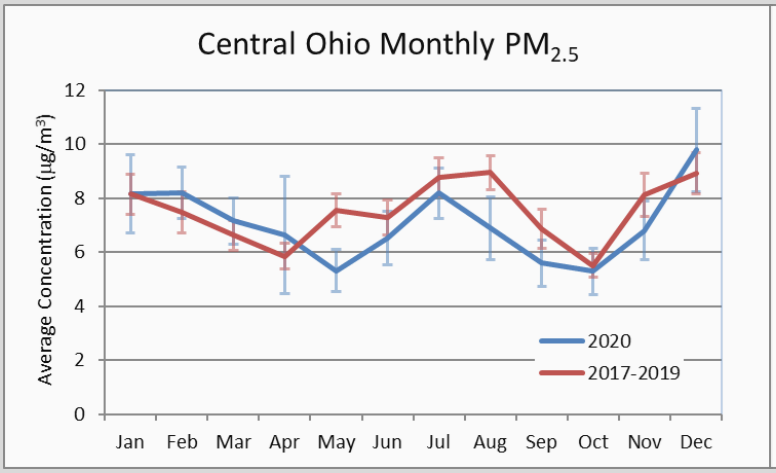
ANALYSIS OF POLLUTANT LEVELS DURING COVID RESTRICTIONS

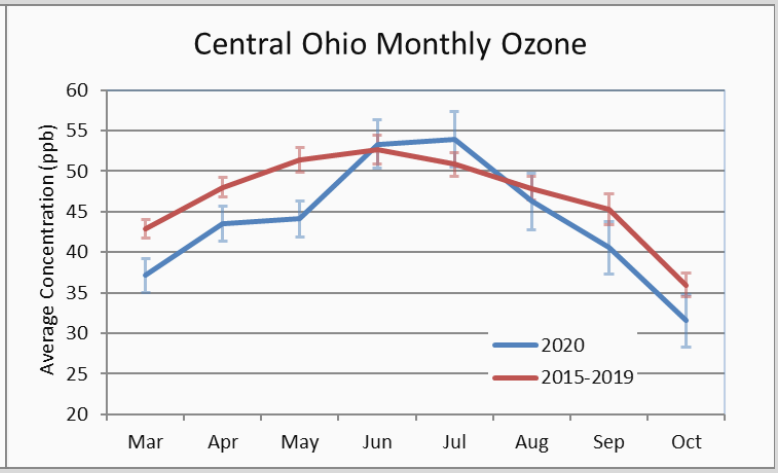
In March 2020, steps were taken to reduce the spread of COVID – 19 in Ohio, including business closures and stay-at-home orders. Some of those restrictions continued into May and beyond. It is possible that the reduced industry, travel, and other activities improved air quality due to reduced emissions. This brief analysis provides a preliminary look at air quality trends in 2020 compared to previous years in order to explore whether such an improvement may have been observed and whether that improvement may have been due to COVID – related reduced emissions.

STI meteorologists compared monthly average $PM_{2.5}$ and ozone concentrations observed in Central Ohio in 2020 to those observed in recent prior years. The graphs below show those averages, along with error bars representing 95% confidence intervals. In a given month, if the average concentration in 2020 differs from the average for prior years, and the error bars do not overlap, the differences in the averages are said to be statistically significant.

$PM_{2.5}$ monthly average concentrations in 2020 were lower than the 2017 – 2019 averages for all months from May through November. However, the differences were statistically significant for the months of May and August only.

Ozone monthly average concentrations in 2020 were lower than the 2015 – 2019 averages, with statistical significance, for the months of March, April, and May.





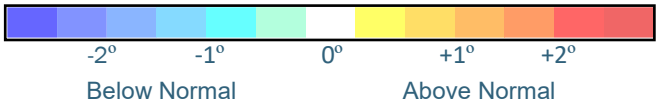
Because air quality depends on both pollutant emissions and meteorology, it is crucial to factor in meteorological patterns when examining year-to-year trends in observed air quality. For example, during the months of April and May, ozone levels were lower in 2020 compared to the 2015 – 2019 average. However, those months were cooler and wetter than average (see page 4) — conditions which typically lead to lower ozone concentrations, even without emissions reductions. Conversely, ozone levels in July 2020 were slightly higher than those observed from 2015 – 2019. However, those months were warmer and drier than average — conditions which lead to higher ozone concentrations.

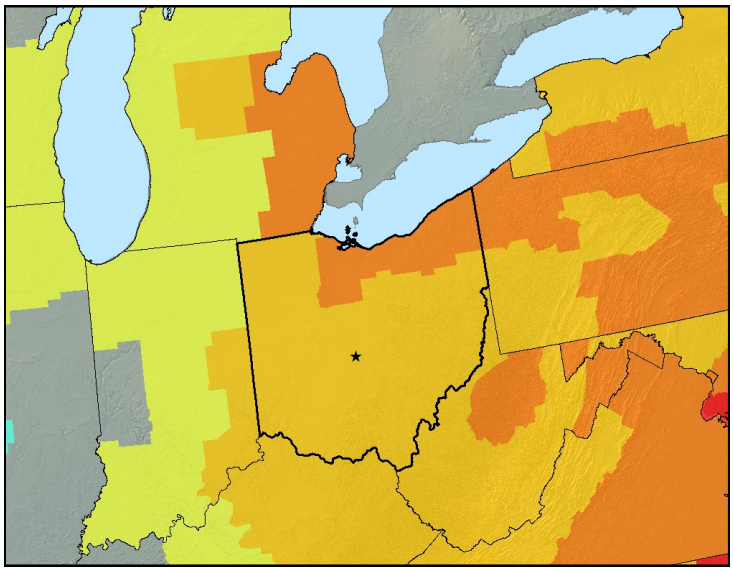
For the months of May and August 2020, wind speeds and precipitation — which can have significant impacts on $PM_{2.5}$ concentrations — were near normal. This would suggest that the statistically significant reduction in $PM_{2.5}$ may have been tied to reduced emissions associated with COVID restrictions.

These preliminary results show a slight reduction in $PM_{2.5}$ and ozone pollution during several months in 2020, which may be attributed to reduced emissions during COVID restrictions. However, further analyses which correct for variations in weather are needed to more definitively link pollutant reductions to COVID-related reduced emissions.

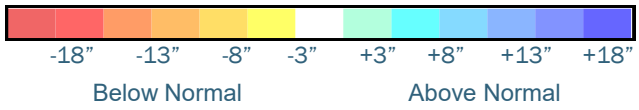
SEASONAL WEATHER SUMMARY

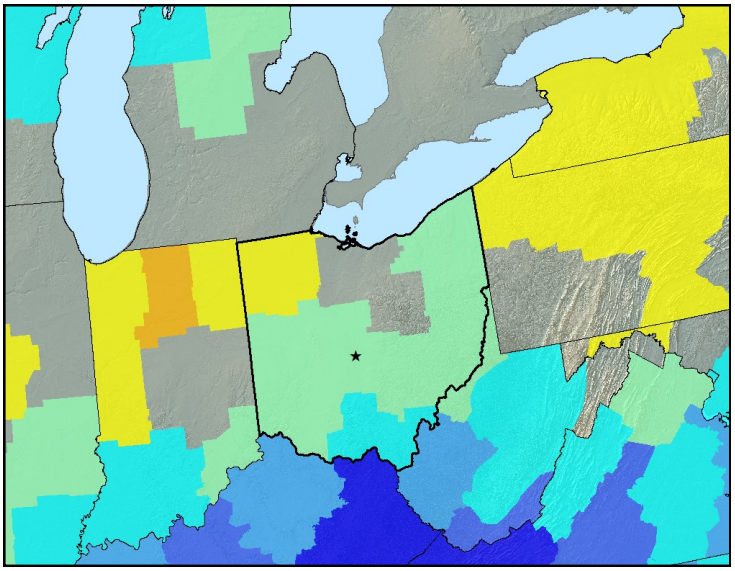
Temperature Anomalies (°F)
November 2019 – October 2020
Versus 1981 – 2010 Average





Precipitation Anomalies (inches)
November 2019 – October 2020
Versus 1981 – 2010 Average





Weather patterns can have a strong impact on air quality in Central Ohio. Temperatures were slightly higher than average during the 2019 – 20 forecast season. Precipitation was above average.

Stagnant weather conditions in December 2019 caused a stretch of four days with Moderate particulate matter pollution levels.

In June and July, temperatures were hotter and there was less precipitation than average. These conditions increased the amount of ozone air pollution, leading to the occurrence of 70% of the Moderate level ozone pollution days for the year.

Both Unhealthy for Sensitive Groups AQI days during the forecast season occurred in July. A summary of these days is provided on page 8.

Columbus, Ohio	Temperature departure from normal (°F)	Precipitation departure from normal (inches)	Moderate or higher $PM_{2.5}$ days	Moderate or higher ozone days
November	-5.6	-1.72	3	--
December	+3.9	-0.21	4	--
January	+7.1	+1.64	3	--
February	+0.8	+0.31	2	--
March	+4.6	+5.14	0	0
April	-3.9	+0.82	1	1
May	-2.5	+2.12	0	2
June	+1.8	-1.61	1	13
July	+4.1	-1.17	2	14
August	+0.5	+1.43	3	5
September	-0.3	+1.46	0	3
October	-0.5	+1.58	0	0

Red: warmer-than-normal temperatures. Blue: colder-than-normal temperatures. Green: wetter-than-normal conditions. Brown: drier-than-normal conditions.

Meteorological data courtesy of the National Weather Service, w2.weather.gov/climate/index.php.

OZONE SUMMARY AND HIGHEST AQI DAYS: 2020

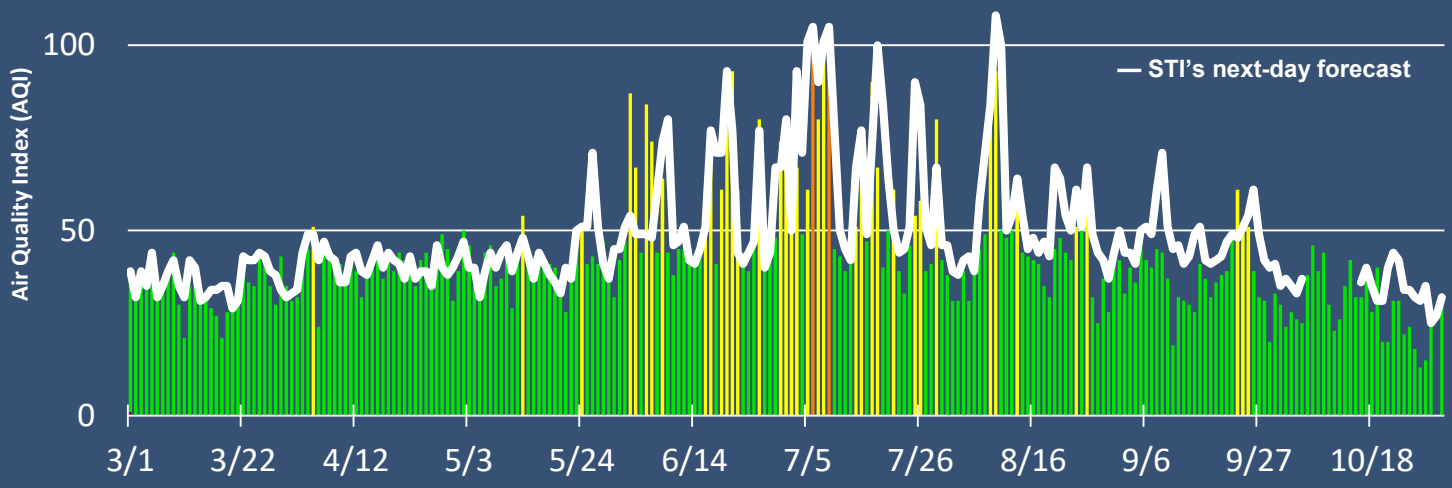
The table below shows the forecast and observed ozone AQI levels on days with forecast AQI levels above 100 or observed AQI levels at or above 90. Five Air Quality Alerts were issued during the year, with USG AQI levels observed on two days. Brief descriptions of weather conditions on selected high-AQI days (shown in bold in the table below) are provided on the following page.

Prevailing winds are frequently from the southwest or west on days with observed AQI levels above 100, leading to maximum readings at monitors to the northeast of major urban centers, such as the New Albany and London monitoring sites, due to pollution transport.

Date	Next-Day Forecast	Same-Day Forecast	Observed Ozone AQI	Peak Monitor
6/21/20	77	84	93	New Albany
7/5/20	101	101	61	New Albany
7/6/20	**105**	**105**	**101**	**Maple Canyon Dr.**
7/8/20	101	101	100	Maple Canyon Dr.
7/9/20	**105**	**105**	**101**	**Delaware**
7/17/20	74	67	90	New Albany
8/9/20	**108**	**108**	**93**	**New Albany**

STI meteorologists were generally able to capture the trend of observed air quality levels with their next-day forecasts. The chart below shows daily observed AQI levels (colored bars) and next-day forecasts (white line) for ozone.

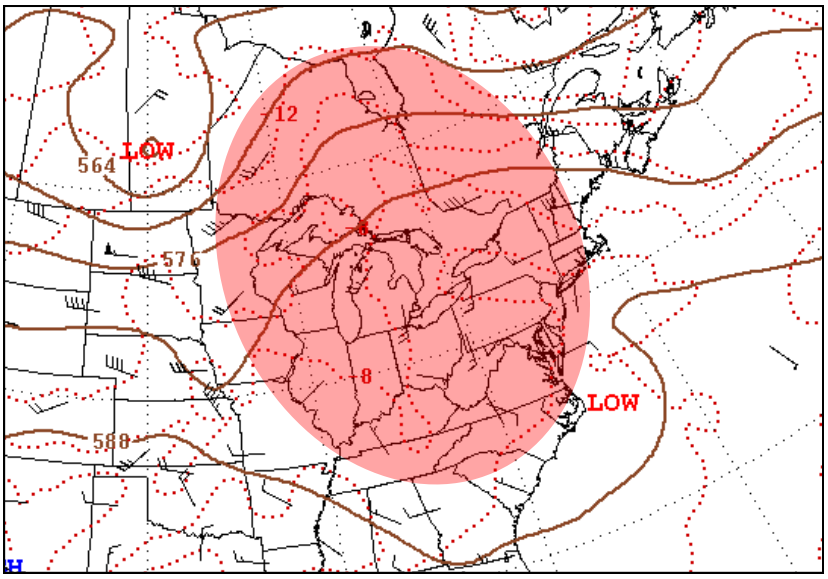
DAILY MAXIMUM OZONE AQI VALUES AND FORECASTS MARCH–OCTOBER 2020



HIGHLIGHTED DAYS: OZONE

JULY 6 & 9, 2020: 101 AQI

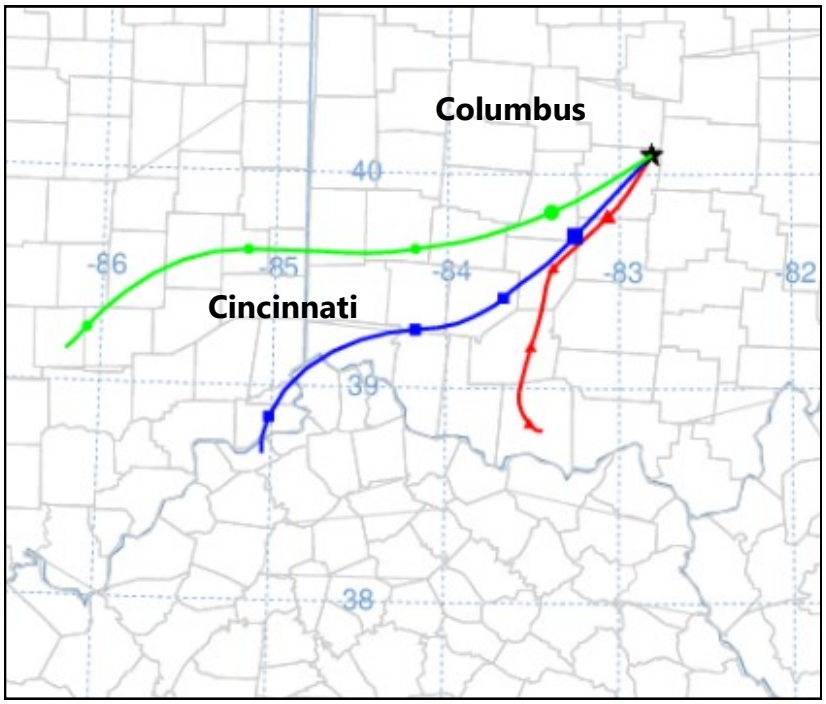
Ozone levels on these days reached 101 AQI, the highest observed levels for the year. During this period, an upper-level ridge of high pressure passing over the Buckeye State inhibited vertical mixing in the lower levels of the atmosphere. At the surface, calm-to-light winds hindered pollutant dispersion, while partly to mostly sunny skies and temperatures in the mid- to upper-90s enhanced ground-level ozone formation. These conditions, combined with day-to-day pollutant carryover, caused AQI levels to reach the Unhealthy for Sensitive Groups category at the Maple Canyon Drive monitoring site on July 6 and at the Delaware monitoring site on the July 9.



July 9: 500 mb weather map showing an upper-level ridge of high pressure over Ohio and Ontario (denoted by the red shading). *Image from https://www.wpc.ncep.noaa.gov*

AUGUST 9, 2020: 93 AQI

August 9 was an Air Quality Alert day in Columbus, with a next-day forecast of 108 AQI. On this day, temperatures near 90°F and mostly sunny skies enhanced ozone production. Additionally, surface high pressure over West Virginia generated periods of southwesterly winds, which transported regional pollutants into central Ohio. However, gradually rising dew points throughout the day increased instability in the lower levels of the atmosphere, aiding vertical mixing. These conditions resulted in an observed AQI value of 93 at the New Albany monitoring site, which is in the high-Moderate category.



August 9: 24-hour backward trajectories ending at 12 a.m. on August 10 show low-level winds from the southwest. These winds transported regional pollutants into Columbus. Trajectories are shown for elevations of 100 m (red), 500 m (blue), and 1,000 m (green) above ground level. *Image from https://ready.arl.noaa.gov*

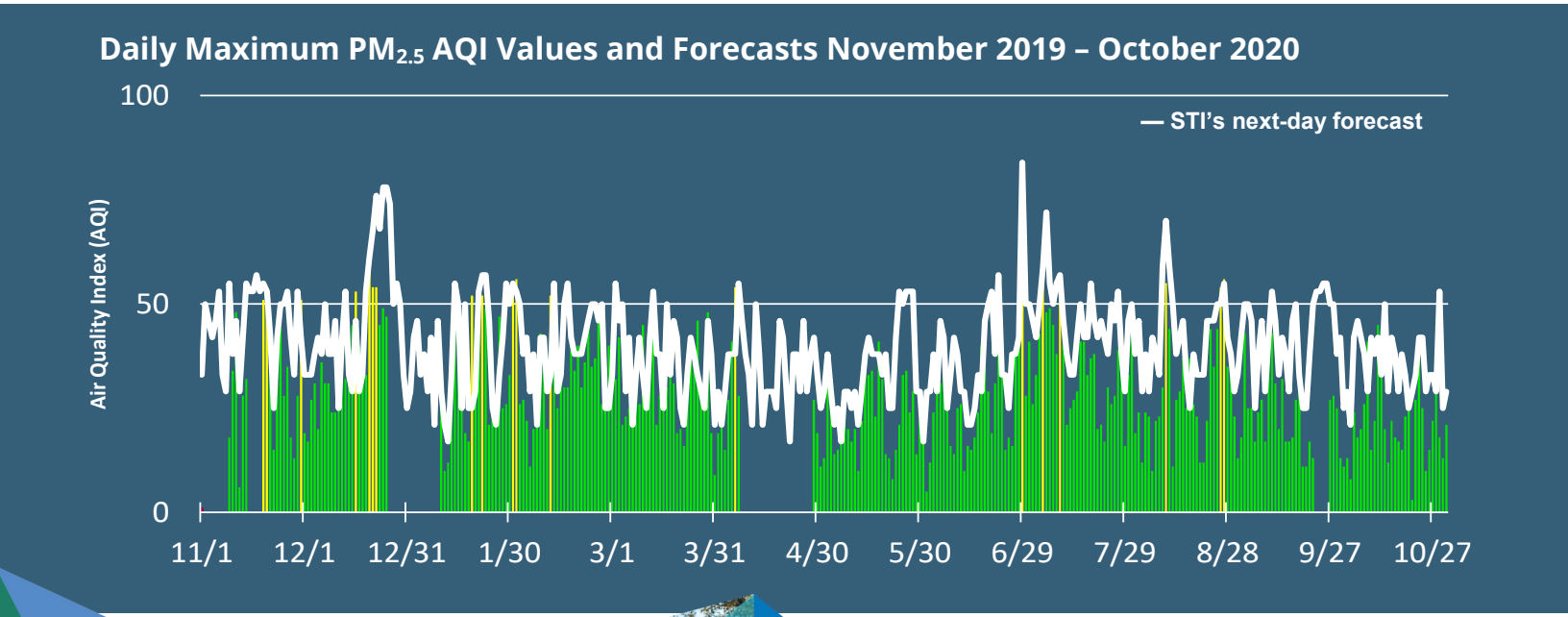
$PM_{2.5}$ SUMMARY AND HIGHEST AQI DAYS: 2019 – 2020

The table below shows $PM_{2.5}$ AQI levels on days with forecast AQI levels above 75 or observed AQI levels of 55 or higher. No Air Quality Alerts were issued for $PM_{2.5}$, and no days with an AQI above 100 were observed.

Prevailing winds are frequently from the southwest or west on days with observed AQI levels above 100, leading to maximum readings at monitors to the northeast of major urban centers, such as the New Albany and London monitoring sites, due to pollution transport.

Date	Next-Day Forecast	Same-Day Forecast	Observed $PM_{2.5}$ AQI	Peak Monitor
12/20/19	61	61	59	New Albany
12/22/19	76	80	54	New Albany
12/24/19	78	68	49	New Albany
12/25/19	78	76	47	New Albany
2/1/20	53	63	56	New Albany
6/28/20	84	59	54	New Albany
7/4/20	59	80	55	New Albany
8/9/20	70	55	55	New Albany
8/26/20	55	53	56	New Albany

STI meteorologists were generally able to capture the trend of observed air quality levels with their next-day forecasts. The chart below shows daily observed AQI levels (colored bars) and next-day forecasts (white line) for $PM_{2.5}$. No bars are shown for days with missing observed AQI values.



FORECAST STATISTICS

STI provides same-day, next-day, and extended AQI daily forecasts for central Ohio. A statistical summary of same-day and next-day forecasting performance at the Good-to-Moderate AQI threshold (51 AQI) is shown in the charts on the right and described below.

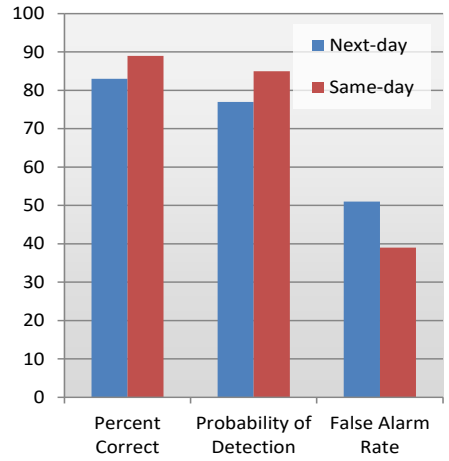
Of the 235 next-day ozone forecasts issued, 195 were correct at the Good-to-Moderate threshold, resulting in a Percent Correct (PC) of 83%. Of the 40 days with observed moderate or higher AQI levels, 31 were correctly predicted in the next-day forecast, resulting in a Probability of Detection (POD) of 77%. The False Alarm Rate (FAR) for the next-day forecasts was 51%.

USG ozone AQI levels were observed on two days in central Ohio during summer 2020, which were accurately predicted by the next-day and same-day forecasts. In all, Air Quality Alerts (next-day or same-day forecasts above 100 AQI) were issued on five days during summer 2020. While two of these days verified with USG ozone levels, the other three days recorded observed ozone levels in the mid- to high-Moderate category.

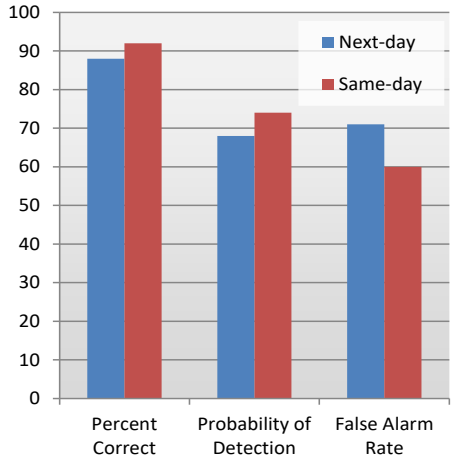
Of the next-day $PM_{2.5}$ forecasts issued when valid data was measured (315 days), 277 were correct at the Good-to-Moderate threshold, resulting in a PC of 88%. Of the 19 days with observed Moderate AQI levels, 13 were correctly predicted in the next-day forecast, resulting in a POD of 68%. The FAR for the next-day forecasts was 71%; however, the average bias for next-day forecasts was only 2.4 µg/m^3.

The table below shows the forecast statistics for the Columbus region.

Good-to-Moderate Ozone Forecast Statistics, March – Oct. 2020



Good-to-Moderate $PM_{2.5}$ Forecast Statistics, Nov. 2019 – Oct. 2020



Pollutant	Good-to-Moderate Threshold									
	Same Day					Next Day				
	Percent Correct	Probability of Detection	False Alarm Rate	Bias	MAE	Percent Correct	Probability of Detection	False Alarm Rate	Bias	MAE
$PM_{2.5}$	92	74	60	+1.9	2.2 µg/m^3	88	68	71	+2.4 µg/m^3	3.1 µg/m^3
Ozone	89	85	39	+2.7 ppb	5.1 ppb	83	77	51	+4.2 ppb	6.6 ppb

STATISTICAL DEFINITIONS

Percent Correct
threshold.

Probability of Detection: The ability to correctly predict high-pollution events at or above a certain threshold.

False Alarm Rate: The percentage of cases for which a forecast of high pollution was incorrect at or above a certain threshold.

Bias: The average difference between forecast and observed concentrations. A positive bias indicates that the forecast concentrations tended to be higher than observed concentrations. A negative bias indicates that the forecast concentrations tended to be lower than observed.

Mean Absolute Error (MAE): Indicates the average absolute difference between forecast and observed concentrations. A low MAE suggests that forecasts tend to be fairly accurate.

FOR MORE INFORMATION:

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