



CLIMATE CHANGE: AIR POLLUTION AND ALLERGENS

Climate change is a significant transformation in average environmental conditions that occurs over years, decades, centuries, or longer. Natural and human activities that change the types and amounts of particles and gases in the atmosphere (the air that surrounds a planet) cause climate change. Knowing where gases and particles in our atmosphere are located and how much of each is present is important to understanding and predicting conditions on our planet. The substances that make up our atmosphere influence environmental conditions (like temperature, humidity, and pressure) and impact health when humans are exposed to them. Scientists use instruments on the ground and satellites orbiting Earth to collect information about what is in our air.

Air quality is a measure of how clean or polluted air is. “Pollutants” are substances that have harmful or poisonous effects on health. “Pollution” describes these harmful substances or the act of putting them into the environment. The United States Environmental Protection Agency (EPA) created a tool called the Air Quality Index (AQI) that focuses on five major pollutants: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. Hazard level boundaries for each pollutant are based on scientific evidence and are reevaluated by the EPA as methods, instruments, and knowledge improve.

AQI values range from 0 for the cleanest, least polluted air to 500 for the most polluted air and have color-coded categories (Table 1). Importantly, the AQI allows scientists to take pollutants that are measured in different units (for example, parts per million, parts per billion, and $\mu\text{g}/\text{m}^3$) and compare them on the same scale.

Table 1. Names and colors of Air Quality Index categories¹

Air Quality Index Value	Description	Color
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Source: Environmental Protection Agency, Technical Assistance Document for the Reporting of Daily Air Quality – the Air Quality Index (AQI), September 2018

Note: Values above 500 are considered “Beyond the AQI.” Follow recommendations for the Hazardous category.



Air quality can vary greatly across times and locations. The AQI reports generated by scientists for your location typically show the pollutant with the highest AQI value and warnings for AQI values above 50, which are often for ozone and particle pollution as they are important sources of unhealthy air quality in cities (Table 2).

Table 2. Pollutant-Specific Sensitive Groups¹

Pollutant with Air Quality Index above 100	Sensitive Groups
Ozone (O ₃)	Children, older adults, people who are active outdoors, people with lung disease, people with certain genetic variants, and people with diets limited in certain nutrients
Particulate Pollution aka Particulate Matter (PM ₁₀ or PM _{2.5})	Children, older adults, and people with heart or lung disease, people of lower socioeconomic status
Carbon Monoxide (CO)	People with heart disease
Nitrogen Dioxide (NO ₂)	Children, older adults, and people with asthma
Sulfur Dioxide (SO ₂)	Children, older adults, and people with asthma

Source: Environmental Protection Agency, Technical Assistance Document for the Reporting of Daily Air Quality – the Air Quality Index (AQI), September 2018

While ozone in the upper parts of the atmosphere can be helpful, ozone causes problems when it is found in the troposphere, the closest atmospheric layer to Earth. Breathing ground-level ozone can result in inflammation of airways, coughing, throat irritation, chest tightness, wheezing, or shortness of breath. Higher ground-level ozone concentrations are associated with increased asthma attacks, increased hospital admissions, and increased absences from work and school. Sensitive persons are advised to stay indoors when ozone concentrations are dangerous.

Ground-level ozone mainly forms through reactions between two major types of air pollutants: volatile organic compounds (VOCs) and nitrogen oxides (NO_x). Some VOCs and NO_x are produced naturally through activities like lightning strikes and forest fires, but most enter the air through human activities. Chemical plants, gasoline pumps, oil-based paints, and autobody shops are major sources of VOCs. Nitrogen oxides often form through high temperature combustion and are released from power plants, industrial furnaces and boilers, and motor vehicles. One nitrogen oxide, called nitrogen dioxide (NO₂), is one of the five major pollutants covered by the AQI.



Particle pollution, also known as particulate matter (PM), is a mixture of solid particles and liquid droplets found in the air. These particles are found in many forms and can be made up of hundreds of different chemicals. Smokestacks, construction sites, and fires can release PM, but most particles form through the complex reactions of chemicals. For example, reactions involving sulfur dioxide (one of the major pollutants covered by the AQI) and NO_x contribute to PM. Like NO_x, sulfur dioxide comes from sources like power plants and motor vehicles.

Scientists measure the width of individual particles using a tiny unit of measure called a micrometer or “micron.” A single human hair is about 50 to 70 micrometers wide. Particle pollution is classified as either PM₁₀ if the particles are 10 micrometers wide or smaller or PM_{2.5} if the particles are 2.5 micrometers wide or smaller. PM₁₀ includes dust, pollen, and mold. The fine PM_{2.5} particles are a special concern because they can be breathed in more easily and deeper into the lungs, can enter your blood, and are a main cause of reduced visibility (haze) in parts of the United States. PM has been linked to eye, lung, and throat irritation, trouble breathing, lung cancer, and low birth weight.

While it may seem difficult to avoid danger in the air we breathe, being aware of air quality in your area can help you take action to reduce your risks of negative health effects from air pollution. Check air quality reports like those on <https://www.airnow.gov/> or many weather apps before making plans. They can help you make informed decisions about whether you may need to limit your time outdoors and avoid activities that make you breathe hard (like going for a walk instead of a run). You will also be able to decide whether to take allergy medication or stay away from busier roads where PM can be high.

Resources

¹Tables adapted from <https://www.airnow.gov/sites/default/files/2020-05/aqi-technical-assistance-document-sept2018.pdf>

<https://scijinks.gov/air-quality/>

<https://www.airnow.gov/aqi/aqi-basics/>

<https://www.epa.gov/ozone-pollution-and-your-patients-health/health-effects-ozone-general-population>

<https://www.epa.gov/pm-pollution/particulate-matter-pm-basics#PM>

https://www.cdc.gov/air/particulate_matter.html

<https://www.climate.gov/news-features/climate-and/climate-allergies>

24/7 Emergency Contact Number: 1-888-295-5156

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