KSCHOOL | DATA SCIENCE MASTER | JULY 2021

MARCOS MARISCAL GARCÍA

HEALTH IS IN AIR

Air Quality Impact in Human's Health

[INTRODUCTION 3](#_Toc76682920)

[Preface 3](#_Toc76682921)

[Motivation 3](#_Toc76682922)

[History 3](#_Toc76682923)

[About Air Quality data 4](#_Toc76682924)

# INTRODUCTION

### Preface

Last December 2020, a historic decision of the British justice recognized that Ella Adoo, a nine years girl, had a serious asthma attack causing her death because of a high level of pollution in South London in 2014

Delivering the narrative verdict, the warrant said that levels of nitrogen dioxide (NO2) near Ella's home exceeded World Health Organization and European Union guidelines.

Giving his conclusion over almost an hour, the coroner said: "I will conclude that Ella died of asthma, contributed to by exposure to excessive air pollution."

Las year World Health organization gives a terrifying death toll; air pollution kills an estimated seven million people worldwide every year.

From smog hanging over cities to smoke inside the home, air pollution poses a major [threat to health](https://www.who.int/airpollution/ambient/health-impacts/en/) and climate. The combined effects of ambient (outdoor) and household air pollution cause about seven million premature deaths every year, largely as a result of increased mortality from stroke, heart disease, chronic obstructive pulmonary disease, lung cancer and acute respiratory infections.

### Motivation

Since a member of my family had been diagnosed asthma, I am really concern about effects of Air pollution in human’s health. Our vacation destinations are always oriented to places with a good air quality. With this ever-present concern, we have learned to distinguish all the factors to take into account to know the quality of the air in a given place and time.

### Lessons from History

#### Donora. 1948

In October 1948, Donora, Pennsylvania, was enveloped in a lethal haze.

Over five days, nearly half of the town's 14,000 residents experienced severe respiratory or cardiovascular problems. It was difficult to breathe. The death toll rose to nearly 40.

Disturbing photos show Donora's streets hidden under a thick blanket of gray smog. A warm air pocket had passed high above the town, trapping cooler air below and sealing in pollutants.

|  |  |
| --- | --- |
| Nieblas asesinas, ¿fenómeno natural o paranormal? | La niebla tóxica de Donora de 1948 - el blog insostenible |

The situation in Donora was extreme, but it reflected a trend. Air pollution had become a harsh consequence of industrial growth across the country and world.

#### Meuse River valley. 1930

Belgium’s Meuse River valley has long been an inviting tourist destination. From Belgium it then crosses into Holland, where its name changes to the Maas River.

But for almost five days starting December 1, 1930, this scenic valley was occupied by a creeping horror — a wet, impenetrable and extremely toxic fog, centered at the town of Engis. Before it lifted completely on December 6 1930, 65 residents of Engis and several other towns, who had been exposed to the dense clouds, had died horrible, choking deaths. Hundreds of others were stricken with mysterious respiratory illnesses, and thousands of cattle, horses and other farm livestock asphyxiated and died in the fields “like flies sprayed with poison gas.”

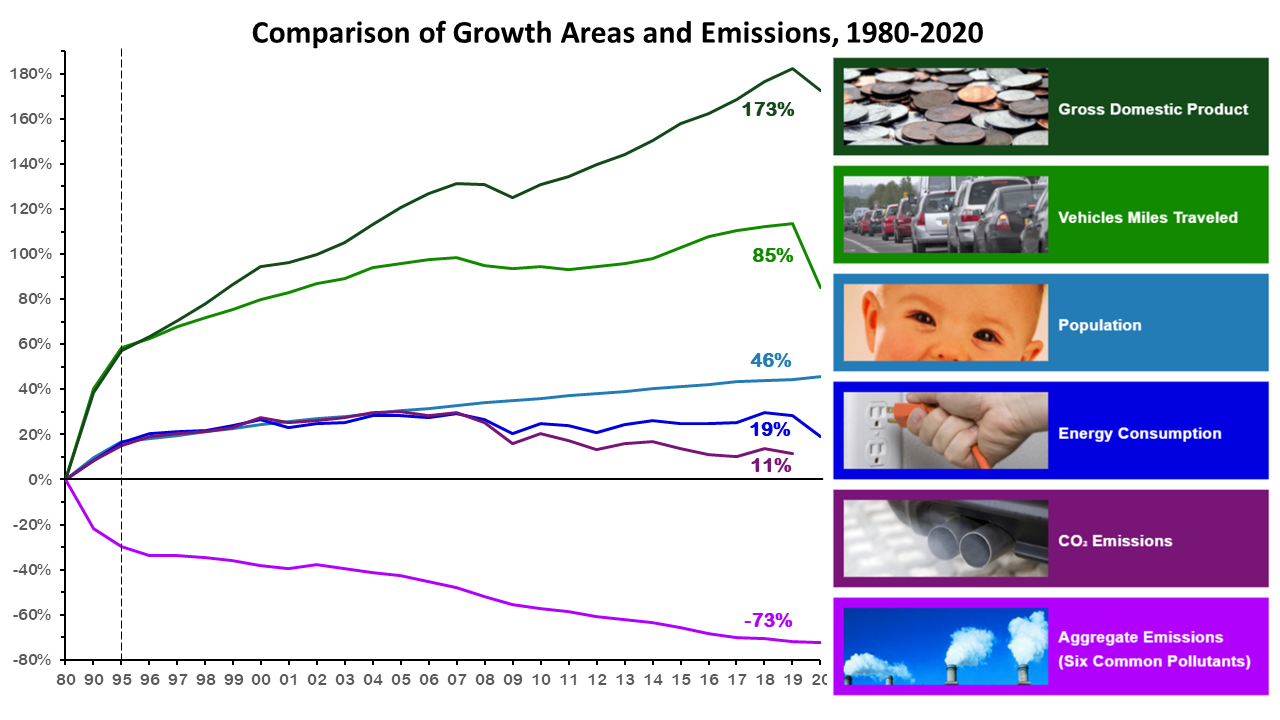
### About Air Quality data

The Air Quality Index, or AQI, was developed by the U.S. Environmental Protection Agency (EPA) to provide a simple, uniform way to report daily air quality conditions.

EPA creates air quality trends using measurements from monitors located across the country. The table below show that air quality based on concentrations of the common pollutants has improved nationally since 1980.

In 2020, about 68 million tons of pollution were emitted into the atmosphere in the United States. These emissions mostly contribute to the formation of ozone and particles, the deposition of acids, and visibility impairment.

The graph below shows that between 1980 and 2020, gross domestic product increased 173 percent, vehicle miles traveled increased 85 percent, energy consumption increased 19 percent, and U.S. population grew by 46 percent. During the same time period, total emissions of the six principal air pollutants dropped by 73 percent. The graph also shows that between 1980 and 2019, CO2 emissions increased by 11 percent.



### Interpreting the AQI

Air Quality Index

Think of the AQI as a yardstick that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 or below represents good air quality, while an AQI value over 300 represents hazardous air quality.

The AQI is divided into six categories. Each category corresponds to a different level of health concern. Each category also has a specific color. The color makes it easy for people to quickly determine whether air quality is reaching unhealthy levels in their communities

| **Daily AQI Color** | | **Levels of Concern** | **Values of Index** | **Description of Air Quality** |
| --- | --- | --- | --- | --- |
| **Green** | **Good** | | **0 to 50** | **Air quality is satisfactory, and air pollution poses little or no risk.** |
| **Yellow** | **Moderate** | | **51 to 100** | **Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.** |
| **Orange** | **Unhealthy for Sensitive Groups** | | **101 to 150** | **Members of sensitive groups may experience health effects. The general public is less likely to be affected.** |
| **Red** | **Unhealthy** | | **151 to 200** | **Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.** |
| **Purple** | **Very Unhealthy** | | **201 to 300** | **Health alert: The risk of health effects is increased for everyone.** |
| **Maroon** | **Hazardous** | | **301 and higher** | **Health warning of emergency conditions: everyone is more likely to be affected.** |

### Which Pollutants Can I Monitor Using the AQI?

AQI numbers are determined by hourly measurements of five pollutants:

* fine particles (PM2.5),
* ground-level ozone (O3)
* sulfur dioxide (SO2)
* nitrogen dioxide (NO2)
* carbon monoxide (CO)

To check the de aka composite AQI, you need to take de maximum of all individual AQI:

AQI = max( AQIPM2.5, AQIPM10, AQIO3, ...)

The pollutant with the highest AQI value determines the overall AQI for that hour.

The five pollutants measured for the AQI are good indicators of daily air quality, but are not the only air pollutants, which may cause health effects, such as air toxics pollutants. Additionally, the AQI does not account for temperature or pollen levels, which may increase sensitivity to air pollutants.

The table below briefly describes each pollutant that goes into the AQI.

|  |  |  |
| --- | --- | --- |
| Pollutant | Abbreviation | Description |
| Ozone | O3 | Ozone is a form of oxygen with three atoms instead of the usual two atoms. It is a photochemical oxidant and, at ground level, is the main component of smog. Unlike other gaseous pollutants, ozone is not emitted directly into the atmosphere. Instead, it is created in the atmosphere by the action of sunlight on volatile organic compounds and nitrogen oxides.  In general, higher levels of ozone usually occur on sunny days with light winds, primarily from March through October. An ozone exceedance day is counted if the measured eight-hour average ozone concentration exceeds the standards. |
| Carbon Monoxide | CO | Carbon monoxide is a colorless, odorless, very toxic gas produced by the incomplete combustion of carbon-containing fuels, most notably by gasoline powered engines, power plants, and wood fires.  The eight-hour standard can be exceeded during winter months when very stable atmospheric conditions exist. |
| Sulfur Dioxide | SO2 | Sulfur dioxide is produced by burning sulfur-containing fuels (such as coal), smelting metallic ores containing sulfur, and removing sulfur from fuels. There are three sulfur dioxide standards which include a 24-hour average, an annual average, and a three-hour average. |
| Nitrogen Dioxide | NO2 | There are several oxides of nitrogen produced by high-temperature combustion. However, the National Ambient Air Quality Standard is only for Nitrogen Dioxide, which has an annual and 1-hour standard. |
| Particulate Matter | PM-2.5 PM-10 | Particle pollution (also called particulate matter or PM) is the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small, they can only be detected using an electron microscope. Particle pollution includes inhalable coarse particles, with diameters larger than 2.5 micrometers and smaller than 10 micrometers and fine particles, with diameters that are 2.5 micrometers and smaller. How small is 2.5 micrometers? Think about a single hair from your head. The average human hair is about 70 micrometers in diameter -- making it 30 times larger than the largest fine particle. These particles come in many sizes and shapes and can be made up of hundreds of different chemicals. Some particles, known as primary particles, are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires. Others form in complicated reactions in the atmosphere of chemicals such as sulfur dioxides and nitrogen oxides that are emitted from power plants, industries and automobiles. These particles, known as secondary particles, make up most of the fine particle pollution in the country.  Coarse particulates (PM-10) come from sources such as windblown dust from the desert or agricultural fields (sand storms) and dust kicked up on unpaved roads by vehicle traffic. PM-10 data is the near real-time measurement of particulate matter 10 microns or less in size from the surrounding air. This measurement is made at standard conditions, meaning it is corrected for local temperature and pressure.  Fine particulates (PM-2.5) are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere when gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds, emitted by combustion activities, are transformed by chemical reactions in the air. Large-scale agricultural burning or sand storms can produce huge volumes of fine particulates. PM-2.5 data is the near real-time measurement of particulate matter 2.5 microns or less in size from the surrounding air. This measurement is made at local conditions, and is not corrected for temperature or pressure. |

# TARGET

My Purpose is to analyze Air Quality data and cross it with the rates of emergency hospital visit related to asthma and other respiratory difficulties.

The idea is to recognize patterns between high levels of pollution in some geographical areas (urban and industrial areas) and the emergency hospital visits because of asthma and other breathings difficulties in the analyzed area

The final target is to generate a predictive model in order to forecast the average hospital visits in future periods regarding air quality conditions.