IT219 Midterm Project

Anthony Quispilaya

Main Idea:

The main idea of this project is to visualize and analyze the relationship between air pollution and respiratory health across the United States over time (2016-2022).

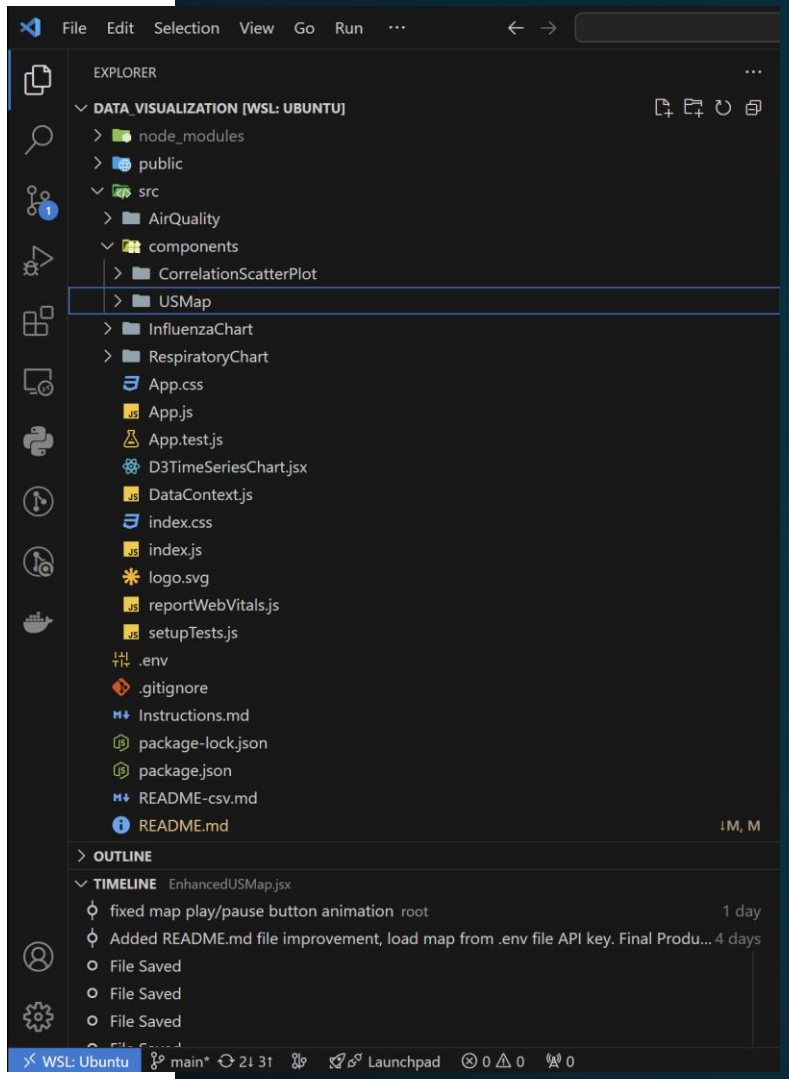
The project addresses the essential question: "Is there a correlation between diminished air quality and respiratory illness rates in the U.S?“

Visuals:

Multi-Time Series Line Charts	Bar Charts	Scatter Plots	Geographical Maps

IDE Setup

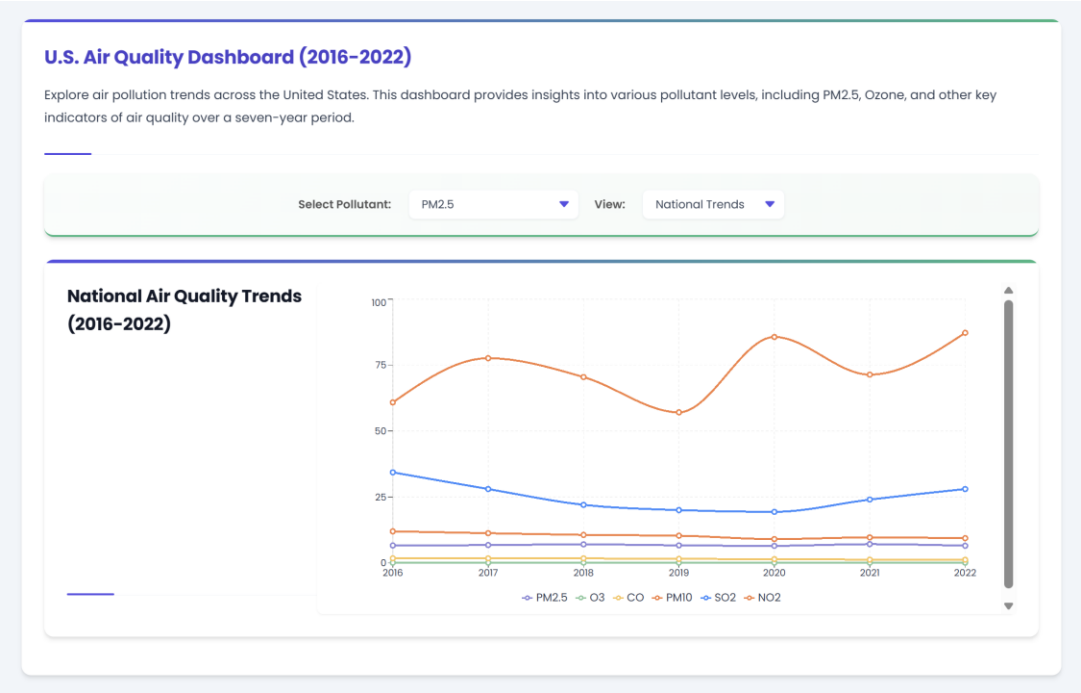
- Inside the public folder, all the data is stored for creating the visual graphs.
- Air, Quality, InfluenzaChart, and RespiratoryChart are folders to store individually the js and css files
- Inside CorrelationScatterPlot and US Map folders their js and css are stored there.
- DataContext.js is a js file to map and properly load data from the public folder
- The .env file has the Google API stored



Air Quality (Lines)

This graph shows U.S. Air Quality Trends (2016–2022) by tracking key pollutants like PM2.5, Ozone (O3), CO, PM10, SO2, and NO2.

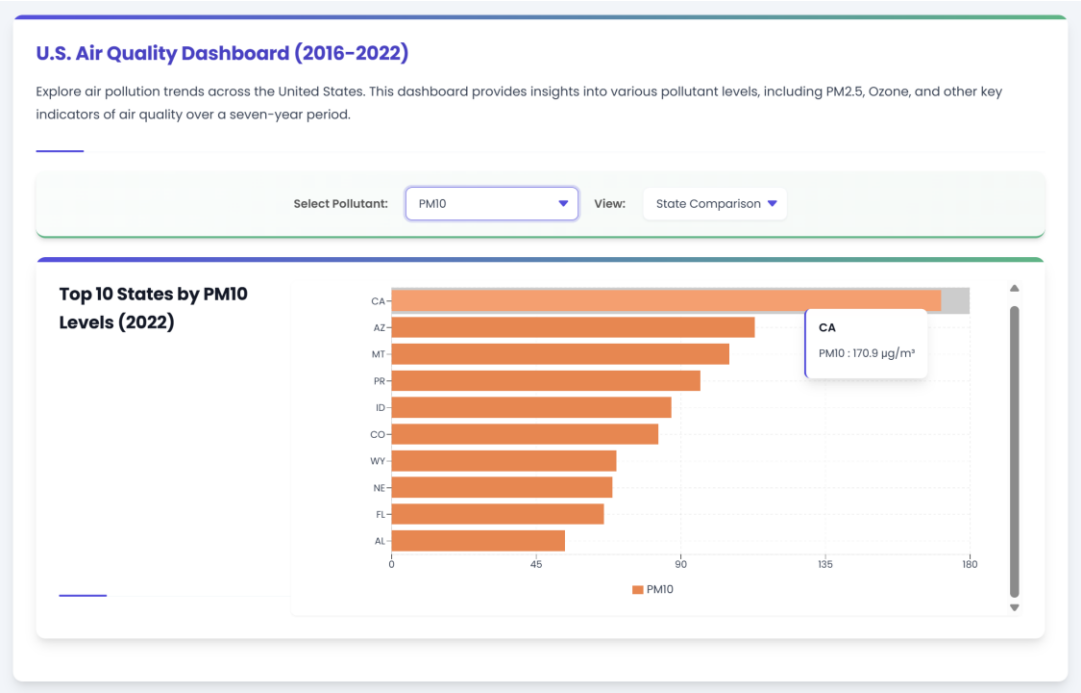
- Trends Over Time: The x-axis represents years, while the y-axis shows pollutant levels.
- Interactive Features: Users can filter pollutants and view different trends.



Air Quality (Bars)

This graph is part of an interactive dashboard that compares environmental data across different U.S. states.

- State Ranking: Displays the top 10 states with the highest recorded levels of a selected factor.
- Customizable Filters: Users can select different data points and compare trends at the state level.
- Tooltip Interactivity: Hovering over a bar reveals precise values for that state.
- Clear Visual Representation: Uses a bar chart for easy comparison of values across multiple states.



Influenza Trend

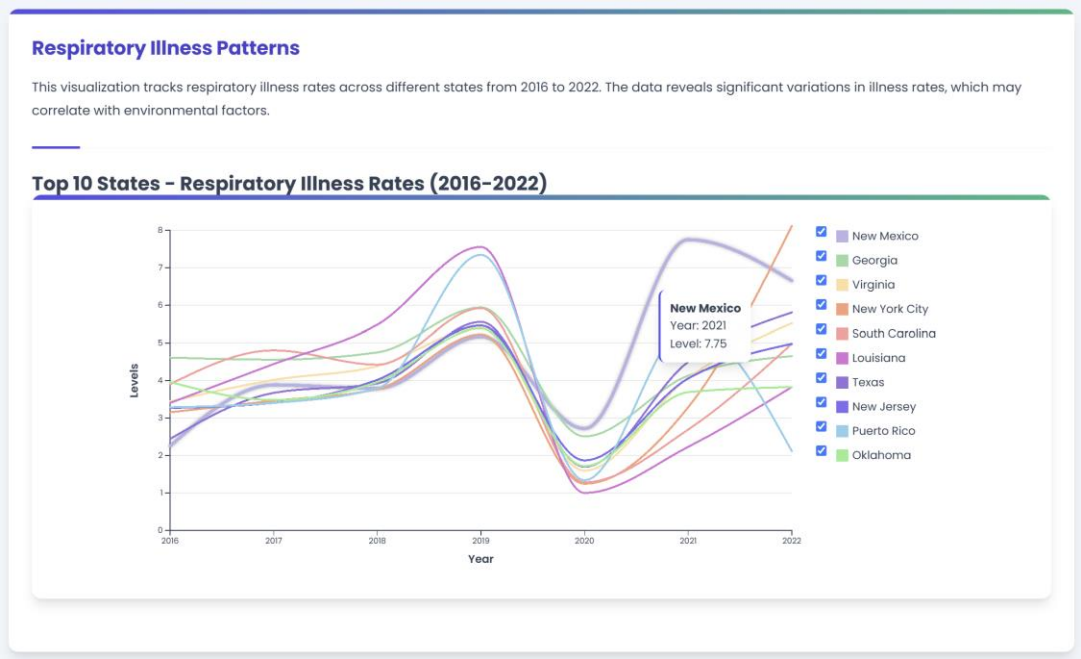
This graph illustrates Influenza Prevalence Trends from 2016 to 2022 in the United States.

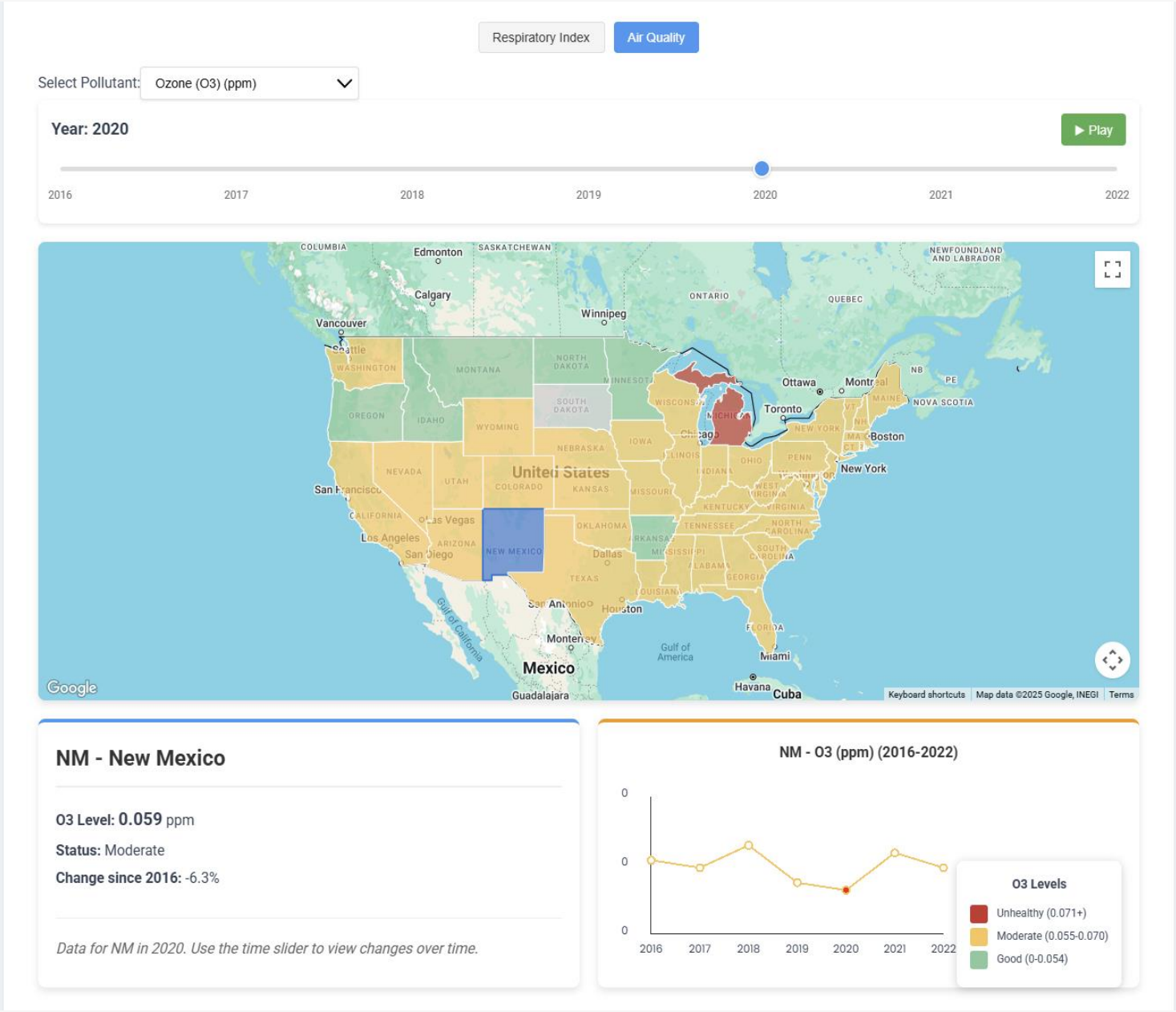
- Tracking Influenza A & B: The graph differentiates between Influenza A (purple), Influenza B (green), and the total number of influenza cases (orange).
- Yearly Positivity Rate: The y-axis represents the positivity rate of influenza cases, while the x-axis marks the years from 2016 to 2022.
- Impact of the COVID-19 Pandemic: There is a clear drop in influenza cases around 2020, coinciding with the COVID-19 pandemic, which may suggest reduced transmission due to public health measures.
- Recovery in 2022: After a sharp decline in 2020 and 2021, influenza cases appear to rise again in 2022.
- Interactive Tooltip: The graph includes a tooltip that allows users to hover over data points and see exact values for each year.

Respiratory Illness Rates

This graph is an interactive visualization that tracks respiratory illness rates across different U.S. states from 2016 to 2022.

- State Comparisons: Displays trends for the top 10 states with the highest respiratory illness rates.
- Time Series Analysis: The x-axis represents years, while the y-axis measures illness levels.
- Color-Coded Lines: Each state is assigned a unique color to differentiate trends.
- Interactive Tooltips: Users can hover over points to view specific values for a given state and year.
- Selectable States: A checkbox list allows users to filter and customize which states are displayed.

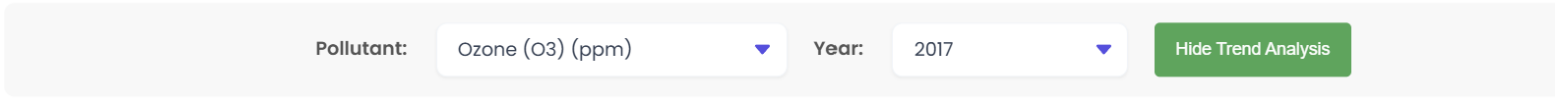




US State Interactive Map

This is an interactive map visualization that tracks health and environmental metrics across U.S. states, allowing users to analyze trends over time.

- Dual Map Views: Users can switch between the Air Quality Map and the Respiratory Index Map for different insights.
- State-Level Data: Clicking on a state provides detailed information about its selected metric.
- Selectable Pollutants: Users can choose from different air quality indicators (e.g., Ozone levels) via a drop-down menu.
- Time Slider: Allows users to adjust the year (2016–2022) and observe trends over time.
- Color-Coded Map: States are shaded based on their pollutant or respiratory index levels, with colors indicating different statuses (e.g., Good, Moderate, Unhealthy).
    - Pollutant concentration or respiratory index level
    - Status classification (e.g., Moderate, Unhealthy)
    - Percentage change compared to previous years
- Trend Graph: A small chart on the right tracks how the selected metric has changed in the state over time.



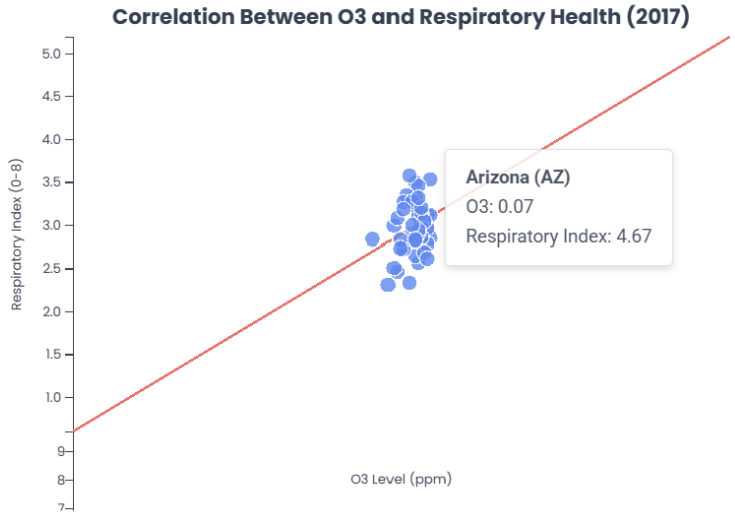
Number of States with Data: 48

Correlation Coefficient (r): 0.283

Interpretation: Data shows a weak positive correlation between O3 levels and respiratory illness rates.

Relationship: As air pollution increases, respiratory health issues tend to increase.

Note: Correlation does not necessarily imply causation. Other factors may influence these relationships.



Correlation Between Air Quality and Respiratory Health

This is a trend analysis dashboard that examines the relationship between air pollution and respiratory health.

- Correlation Analysis: This shows how pollution levels and respiratory illness rates are related.
- Scatter Plot: Visualizes data points for different states, with a trend line indicating correlation.
- Yearly Selection: Users can choose different years to analyze trends.
- Correlation Trend Over Time: A graph tracks how the strength of the relationship changes from year to year.
- Interactive Data Points: Users can hover over points to see specific values for each state.

This tool helps identify patterns in environmental health data and track trends over time.

Key Air Quality Pollutants and Health Impacts

PM2.5 (Fine Particulate Matter): Tiny particles that can penetrate deep into lungs and bloodstream, causing respiratory and cardiovascular issues. Sources include vehicle emissions, industrial processes, wildfires, and power plants. Exposure is linked to asthma, bronchitis, and reduced lung function.

Ozone (O3): Can trigger asthma attacks and worsen other lung conditions. Forms when pollutants from cars, power plants, and other sources react with sunlight. Causes airway inflammation, reduced lung function, and increased hospital visits for respiratory conditions.

Nitrogen Dioxide (NO2): Associated with increased respiratory symptoms, especially in vulnerable populations. Primarily from vehicle emissions and power plants. Causes airway inflammation and increased susceptibility to respiratory infections.

Sulfur Dioxide (SO2): Can cause inflammation and irritation of the respiratory system. Mainly from burning fossil fuels, especially coal. Triggers wheezing, chest tightness, and shortness of breath, particularly in people with asthma.

The Air Quality and Respiratory Health Story

Our analysis reveals a compelling narrative about the relationship between air quality and respiratory health across the United States:

1. Consistent Patterns of Impact

The data tells a clear story: States with higher levels of air pollutants, particularly PM2.5 (fine particulate matter), consistently show higher rates of respiratory illness. This relationship has remained remarkably stable from 2016-2022, suggesting a persistent health effect that transcends short-term fluctuations.

2. Geographic Vulnerability

Hover over the data points to see that certain regions bear a disproportionate burden. States with combinations of industrial activity, wildfire exposure, and population density often show both elevated pollution levels and respiratory illness rates. This geographic pattern highlights environmental justice concerns where certain communities face greater exposure and health consequences.

3. PM2.5: The Silent Respiratory Threat

Among all pollutants studied, PM2.5 shows the strongest and most consistent correlation with respiratory health outcomes. These microscopic particles (smaller than 2.5 micrometers) can bypass the body's natural defenses, penetrating deep into lung tissue and even entering the bloodstream. Their impact appears to be cumulative and widespread, affecting populations across age groups and demographics.

4. The COVID-19 Connection

Notably, correlations strengthened during the 2020-2022 period, coinciding with the COVID-19 pandemic. Emerging research suggests that long-term exposure to air pollution may have increased vulnerability to respiratory infections, including COVID-19, and worsened outcomes for those infected. This highlights how air quality can amplify the impact of other respiratory threats.

Key Conclusions

The correlation between PM2.5 and respiratory illness (avg r=0.51 in recent years) provides clear evidence of a consistent relationship between air quality and public health outcomes.

Geographic variation in both pollutant levels and health impacts indicates certain regions face disproportionate air quality challenges.

The relationship between air quality and respiratory health remained consistent across the study period (2016-2022), indicating a persistent rather than transient effect.

Different pollutants show varying correlations with respiratory illness, with PM2.5 consistently demonstrating the strongest relationship.

The data suggests that even relatively small increases in air pollutant concentrations are associated with measurable changes in respiratory health indicators.

References

- https://www.epa.gov/air-trends/air-quality-cities-and-counties
- https://www.cdc.gov/fluview/surveillance/usmap.html
- https://www.cdc.gov/respiratory-viruses/data/activity-levels.html
- https://aqs.epa.gov/aqsweb/airdata/download_files.html