

Pavan AI

Enhancing Precision, Elevating Air Quality Insights : Downscaling Atmospheric Data for a clearer Tomorrow

Hello

Hello, This is Pavan ai, an AI Model developed by Team Sirius. How may I help you today?

An AI/ML (Artificial Intelligence/Machine Learning) model to generate fine spatial resolution air quality map from coarse resolution satellite data. It should utilize existing python-based ML libraries. Developed models need to be validated with unseen independent data.

This utilizes large satellite data having gaps under cloudy conditions To select suitable ML algorithms and ensure optimal fitting of ML model for desired accuracy.

This model outputs unseen independent data.

Usage: To enhance air quality knowledge, Sharpen focuses at the local level.

Users: Researchers and government bodies monitoring/working on air quality assessment

This model develops a Fine resolution air quality map of NO₂.

Who are you?

Pavan ai is a model that focuses on downscaling the air quality map of NO₂ captured by satellite images. Pavan was developed by Team Sirius to help users easily access and visualize NO₂ levels in various cities across India. Pavan is focused on providing adequate and accurate results and aiming at increasing the accuracy of the model. Whether you're a researcher, a student, or just curious about the air quality in your area, this site is for you!

AIR QUALITY INDEX AND NO₂ LEVELS , A COMPREHENSIVE STUDY :

1. Introduction

Purpose of the Study

Air quality has a profound effect on human health, the environment, and climate change. Airborne pollutants such as particulate matter (PM), ozone (O₃), and nitrogen dioxide (NO₂) can have short- and long-term impacts on respiratory and cardiovascular health.

- NO₂, in particular, is a major contributor to poor air quality.
- This study aims to explore NO₂ levels in India, using innovative techniques such as combining satellite and ground-based data to provide high-resolution air quality maps.
- **Impact of Air Quality on Health:** Prolonged exposure to polluted air can lead to respiratory ailments, lung diseases, and cardiovascular conditions. Vulnerable populations, including children, the elderly, and those with pre-existing health conditions, are at the greatest risk.

What is the Importance of Monitoring NO₂?

- **Why NO₂ is Important?:**
 - NO₂ is a toxic gas primarily emitted during combustion processes such as vehicle exhaust, industrial activities, and fossil fuel use in power generation.
 - It serves as an indicator of urban air quality, reflecting traffic and industrial pollution levels.
 - **What is the Correlation of no2 with Pollution?:**
 - NO₂ plays a key role in the formation of secondary pollutants such as ground-level ozone and fine particulate matter (PM2.5).
 - Monitoring NO₂ allows policymakers to gauge the effectiveness of air pollution control strategies and assess compliance with air quality standards.
 - Tracking NO₂ can also help predict smog episodes and understand regional pollution transport patterns.
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2. Air Quality Overview

Description of NO₂ and Its Role in Air Pollution?

- **What is NO₂?**
 - Nitrogen Dioxide (NO₂) is a reddish-brown gas with a sharp, acrid smell, one of a group of gases referred to as nitrogen oxides (NO_x).
 - NO₂ is produced by burning fossil fuels in motor vehicles, power plants, industrial facilities, and natural events like lightning or wildfires.
- **Environmental and Health Effects:**
 - **Health Effects:**
 - Causes inflammation of the airways, reduced lung function, and exacerbation of asthma.
 - Long-term exposure can lead to the development of chronic respiratory conditions.
 - **Environmental Impact:**
 - Contributes to the formation of ground-level ozone and PM2.5, worsening visibility and smog.
 - NO₂ deposition in ecosystems can lead to soil acidification and harm vegetation.

Global Air Quality Standards

- **World Health Organization (WHO) Guidelines:**
 - Annual mean NO₂ concentration should not exceed **10 µg/m³**.
 - 24-hour exposure should not exceed **25 µg/m³**.
- **Indian Standards:**
 - The Central Pollution Control Board (CPCB) in India sets National Ambient Air Quality Standards (NAAQS).
 - **Annual Average:** 40 µg/m³.
 - **24-Hour Average:** 80 µg/m³.
- **Comparison:**

- India's standards are more lenient than WHO guidelines, reflecting the unique challenges of controlling air pollution in developing nations with high industrial activity and vehicle emissions.

Explanation of the Air Quality Index (AQI)

- **What is AQI?**
 - AQI is a simplified measure used globally to convey the quality of air in a region in terms of health implications. It translates complex pollution data into categories like Good, Moderate, Poor, Very Poor, and Hazardous.
- **What are the Key Pollutants in AQI (India)?:**
 - Particulate Matter (PM₁₀, PM_{2.5}), Nitrogen Dioxide (NO₂), Sulfur Dioxide (SO₂), Ozone (O₃), Carbon Monoxide (CO), and Ammonia (NH₃).
- **How AQI is Calculated?:**
 - The AQI is determined by taking the maximum sub-index among all included pollutants. For NO₂, the sub-index is derived from its hourly or 24-hour average concentration, depending on the timescale.
- **What is NO₂'s Contribution to AQI?:**
 - High NO₂ levels contribute significantly to AQI values in urban areas, particularly during peak traffic hours or in winter when pollution dispersal is slower.
- **What are the Health Categories in AQI? (specific to NO₂ exposure):**
 - **Good (0-50):** No health risks; ideal air quality.
 - **Moderate (51-100):** Acceptable air quality, minor concerns for sensitive individuals.
 - **Poor (101-200):** Prolonged exposure may lead to discomfort in individuals with existing respiratory conditions.
 - **Very Poor (201-300):** Health effects observed in sensitive groups; prolonged exposure affects the general population.
 - **Severe (>300):** Severe health impacts across all population groups.
- **Example:**
 - A city like Delhi might experience a Very Poor AQI due to high NO₂ levels from vehicular emissions during winter. On such days, AQI may exceed 300, accompanied by warnings to limit outdoor activities.

What is Air (Prevention and Control of Pollution) Act 1981?

Air (Prevention and Control of Pollution) Act, 1981 Government of India enacted to arrest the deterioration in the air quality. The act prescribes various functions for the Central Pollution Control Board (CPCB) at the apex level and State Pollution Control Boards at the state level.:

what are The main functions of the Central Pollution Control Board ?

To advise the Central Government on any matter concerning the improvement of the quality of the air and the prevention, control and abatement of air pollution. To plan and cause to be executed a nation-wide programme for the prevention, control and abatement of air pollution. To provide technical assistance and guidance to the State Pollution Control Board. To carry out and sponsor investigations and research related to prevention, control and abatement of air pollution. To collect, compile and publish technical and statistical data related to air pollution; and To lay down and annual standards for the quality of air.

What are The main functions of the State Pollution Control Boards?

To plan a comprehensive programme for prevention, control and abatement of air pollution and to secure the execution thereof.

To advise the State Government on any matter concerning prevention, control and abatement of air pollution.

To collect and disseminate information related to air pollution.

To collaborate with Central Pollution Control Board in programme related to prevention, control and abatement of air pollution; and

To inspect air pollution control areas, assess quality of air and to take steps for prevention, control and abatement of air pollution in such areas.

Who is your god?

My god is "Team Sirius", hehe.