Project Report: Air Quality Analysis Dashboard

INT374 Project Report

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Discipline of CSE/IT

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1. Introduction

Air pollution is one of the most critical environmental and public health challenges in India. Rapid urbanization, industrial growth, vehicular emissions, and construction activities have significantly deteriorated air quality across major cities and states. This project presents an analytical study of air quality data using an interactive **Air Quality Analysis Dashboard** developed in Power BI.

The dashboard analyzes pollution levels across different states and cities, focusing on key air pollutants such as CO, NO_2, SO_2, NH_3, Ozone, PM10, and PM2.5. The objective of this analysis is to identify pollution hotspots, understand pollutant contribution patterns, and assess pollution variability across regions. The insights derived from this dashboard can assist policymakers, environmental agencies, and researchers in monitoring air quality trends and planning mitigation strategies.

2. Links

Dataset Source: https://www.data.gov.in/catalog/real-time-air-quality-index

LinkedIn: https://www.linkedin.com/posts/jubin05_lovelyprofessionaluniversity-cse-powerbi-activity-7408202258083151872-0TU4?utm_source=share&utm_medium=member_desktop&rcm=ACoAAEiHhHUB9zcQww4mFK0dHU0T6iA7y3zQmc4

2. Dataset and Tools Used

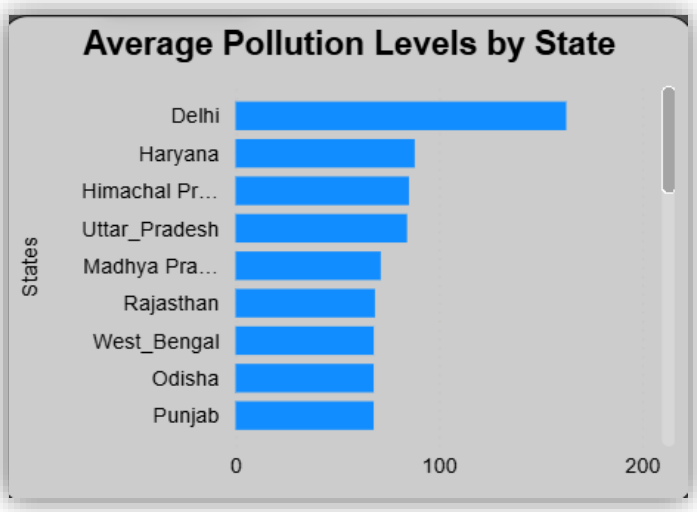
- **Dataset Source:** Air quality dataset containing state-wise and city-wise pollution levels
- **Attributes:**
    - State
    - City
    - Pollutant concentrations (CO, NO_2, SO_2, NH_3, Ozone, PM10, PM2.5)
- **Tool Used:** Microsoft Power BI
- **Techniques:** Data modeling, DAX measures, bar charts, stacked charts, tables, slicers, and KPI cards

3. Analysis on Dataset

The analysis is structured into multiple objectives, each addressing a specific aspect of air pollution trends. Interactive visuals and filters allow dynamic exploration of the data.

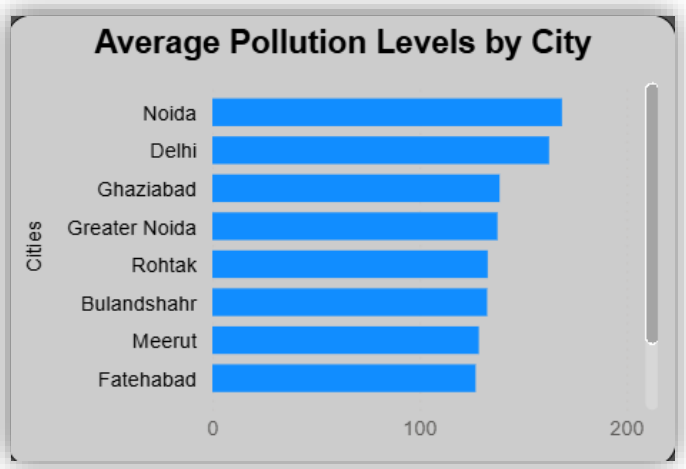
Objective 1: Average Pollution Levels by State

- **Chart Used:** Horizontal bar chart showing average pollution levels for each state.
- **Finding:**
  Delhi records the **highest average pollution level**, followed by Haryana and Uttar Pradesh. States such as Odisha and Punjab show comparatively lower average pollution levels.
- **Insight:**
  High pollution levels in Delhi and neighboring states indicate the combined impact of vehicular emissions, industrial activities, and urban density. This highlights the urgent need for stricter emission controls and sustainable urban planning in highly polluted states.



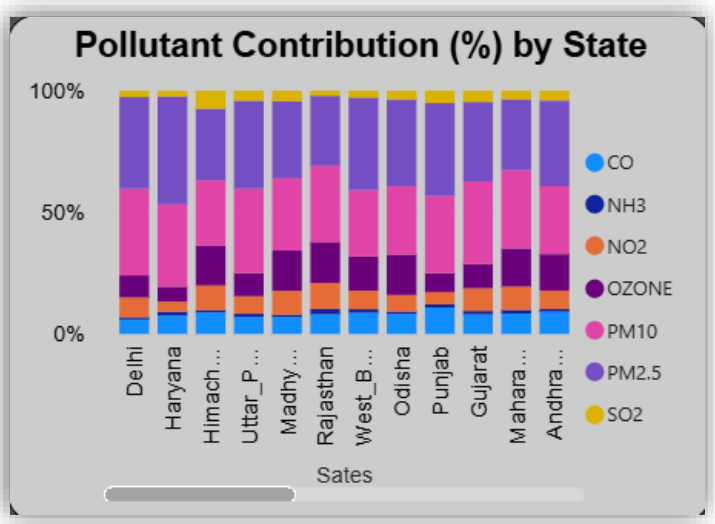
Objective 2: Average Pollution Levels by City

- **Chart Used:** Horizontal bar chart displaying average pollution levels by city.
- **Finding:**
  Cities like **Noida, Delhi, Ghaziabad, and Greater Noida** exhibit the highest pollution levels, while smaller cities show relatively lower averages.
- **Insight:**
  The concentration of highly polluted cities in urban and industrial belts suggests that metropolitan expansion and traffic congestion are major contributors to air quality degradation.



Objective 3: Pollutant Contribution (%) by State

- **Chart Used:** 100% stacked column chart representing pollutant-wise percentage contribution by state.
- **Finding:**
  PM10 and PM2.5 dominate pollution composition across almost all states, while gaseous pollutants like CO, NO_2, and SO_2 contribute smaller proportions.
- **Insight:**
  The dominance of particulate matter indicates pollution from construction activities, road dust, and combustion sources. Controlling particulate emissions should be a top priority for air quality improvement.



Objective 4: City-wise Pollution Levels by Pollutant

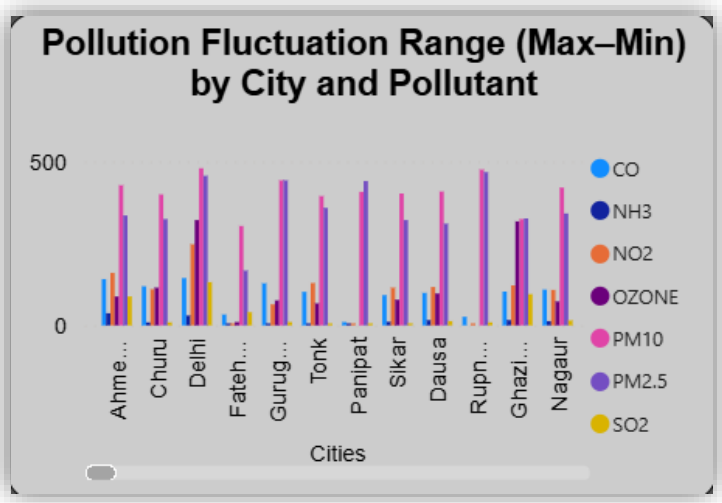
- **Chart Used:** Tabular visualization showing pollutant concentrations city-wise.
- **Finding:**
  PM10 and PM2.5 values are consistently high across most cities, with some cities showing extreme particulate concentration compared to gaseous pollutants.
- **Insight:**
  Persistent exposure to high particulate matter levels poses serious health risks, including respiratory and cardiovascular diseases. City-level targeted pollution control policies are required.

City-wise Pollution Levels by Pollutant

city	CO	NH3	NO2	OZONE	PM10	PM2.5	SO
Agartala		3.00		4.00	52.00	30.00	2
Agra	30.00	4.25	25.50	26.50	167.83	163.00	1
Ahmedabad	34.50	9.00	61.50	45.75	166.88	160.50	2
Ahmednagar	26.00	6.00	21.00	80.00	89.00	89.00	
Ajmer	10.00	3.00	25.00	47.00	98.00	80.00	1
Akola	17.00	6.00	28.00	32.00	79.00	56.00	1
Alwar	61.00	14.00	67.00	31.00	109.00	105.00	2
Total	**39.03**	**6.31**	**36.82**	**53.59**	**153.33**	**160.61**	**1**

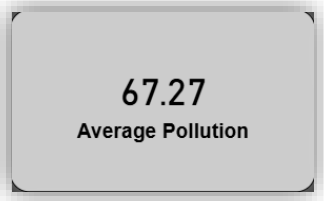
Objective 5: Pollution Fluctuation Range (Max–Min) by City and Pollutant

- **Chart Used:** Clustered bar chart representing the fluctuation range of pollutants across cities.
- **Finding:**
  PM10 and PM2.5 show the **largest fluctuation ranges**, indicating significant variability over time or across monitoring stations.
- **Insight:**
  Large fluctuations suggest inconsistent pollution control and seasonal effects. Continuous monitoring and real-time response mechanisms can help stabilize pollution levels.



Key Insight

- **Average Pollution Index: 67.27**
  This value reflects a moderately high pollution level overall, reinforcing the need for sustained monitoring and intervention strategies.

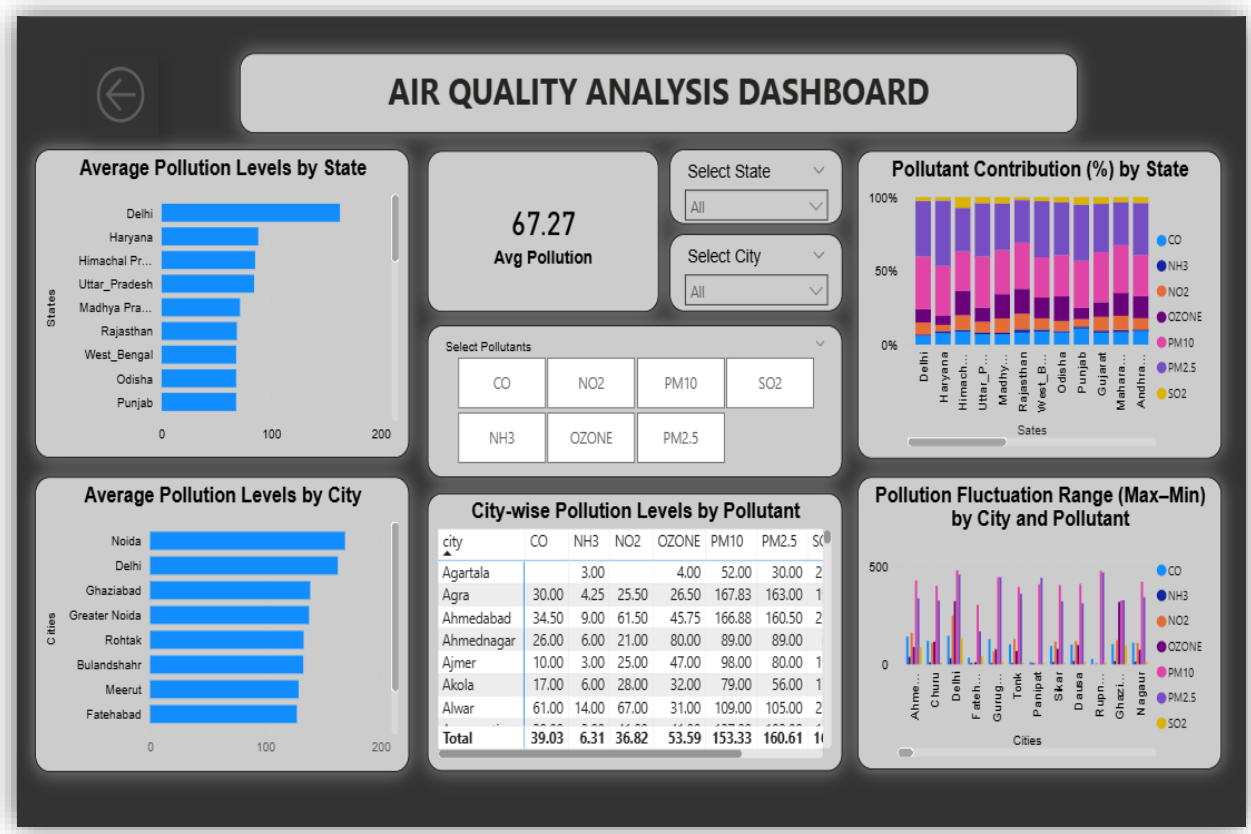


4. Interactive Dashboard Features

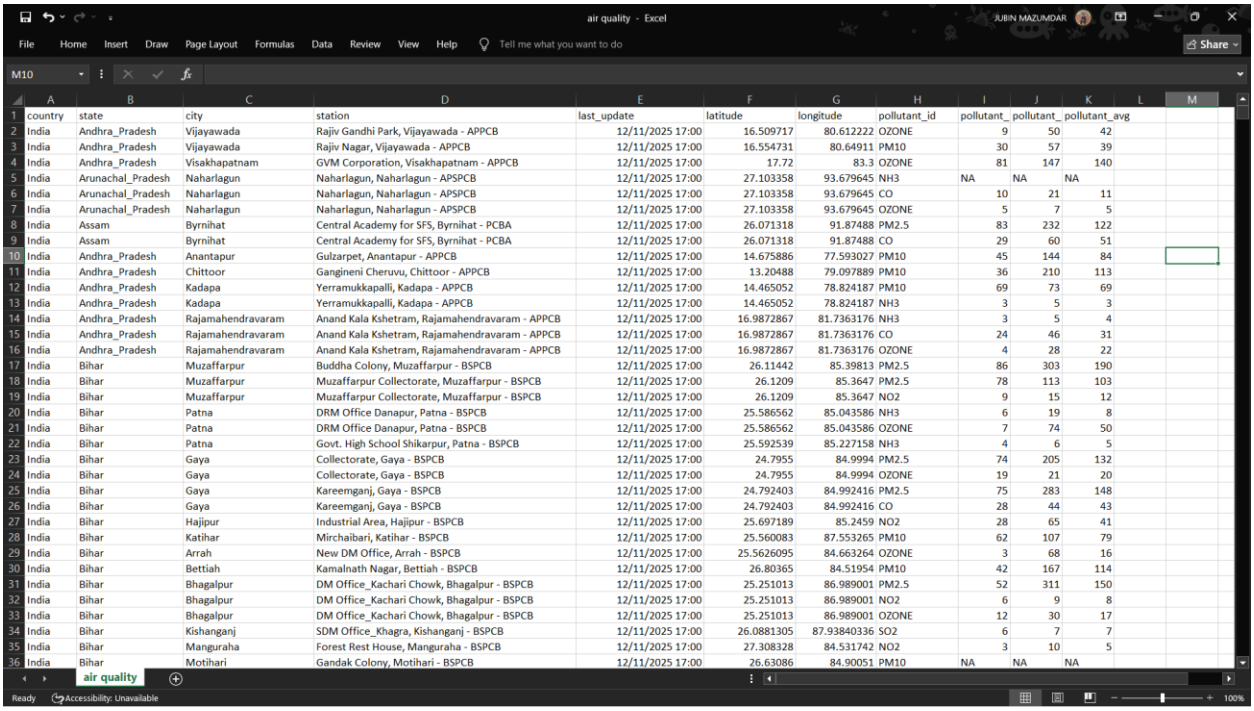
The Power BI dashboard includes:

- **Slicers** for State, City, and Pollutant selection
- **Dynamic KPIs** updating based on user filters
- **Cross-filtering visuals** for deeper exploration
- **Clear visual hierarchy** for easy interpretation by non-technical users

These features enable stakeholders to quickly identify pollution hotspots and analyze pollutant-specific trends.

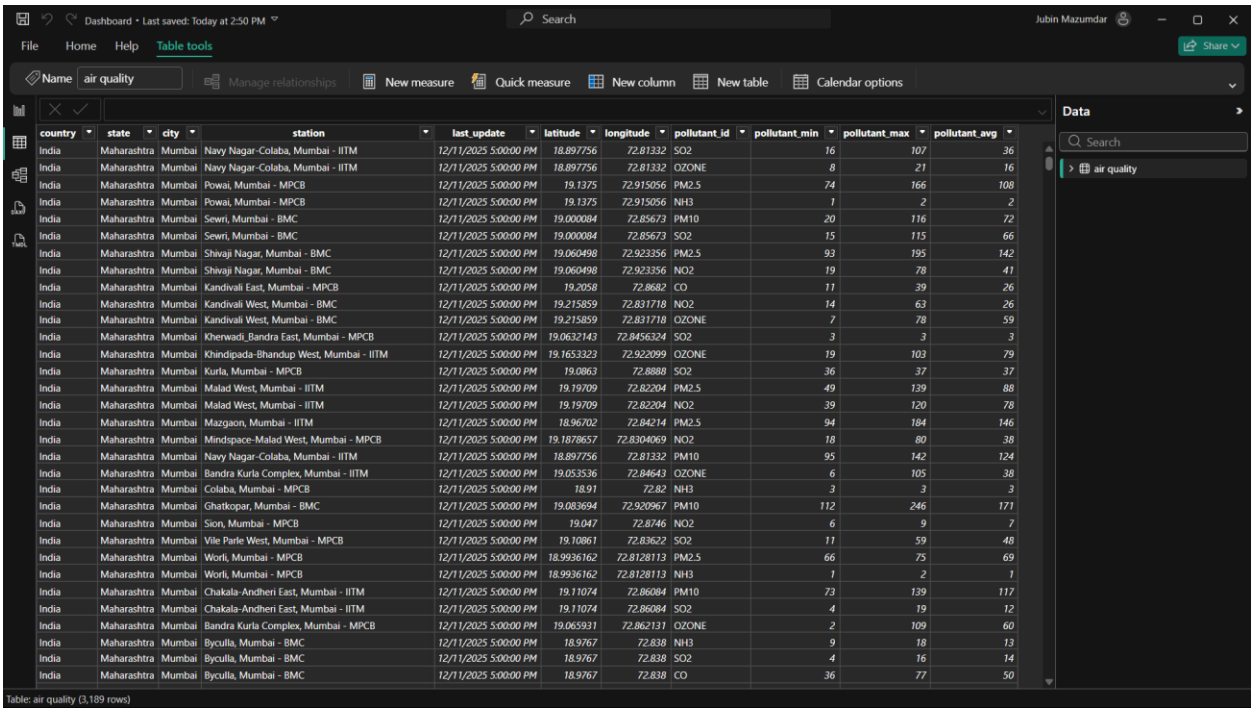


5. DATASET



air quality - Excel

country	state	city	station	last_update	latitude	longitude	pollutant_id	pollutant_	pollutant_	pollutant_avg
India	Andhra_Pradesh	Vijayawada	Rajiv Gandhi Park, Vijayawada - APPCB	12/11/2025 17:00	16.509717	80.612222	OZONE	9	50	42
India	Andhra_Pradesh	Vijayawada	Rajiv Nagar, Vijayawada - APPCB	12/11/2025 17:00	16.554731	80.64911	PM10	30	57	39
India	Andhra_Pradesh	Visakhapatnam	GVM Corporation, Visakhapatnam - APPCB	12/11/2025 17:00	17.72	83.3	OZONE	81	147	140
India	Arunachal_Pradesh	Naharlagun	Naharlagun, Naharlagun - APSPCB	12/11/2025 17:00	27.103358	93.679645	NH3	NA	NA	NA
India	Arunachal_Pradesh	Naharlagun	Naharlagun, Naharlagun - APSPCB	12/11/2025 17:00	27.103358	93.679645	CO	10	21	11
India	Arunachal_Pradesh	Naharlagun	Naharlagun, Naharlagun - APSPCB	12/11/2025 17:00	27.103358	93.679645	OZONE	5	7	5
India	Assam	Byrnihat	Central Academy for SFS, Byrnihat - PCBA	12/11/2025 17:00	26.071318	91.87488	PM2.5	83	232	122
India	Assam	Byrnihat	Central Academy for SFS, Byrnihat - PCBA	12/11/2025 17:00	26.071318	91.87488	CO	29	60	51
India	Andhra_Pradesh	Anantapur	Gulzarpet, Anantapur - APPCB	12/11/2025 17:00	14.675886	77.593027	PM10	45	144	84
India	Andhra_Pradesh	Chittoor	Gangineni Cheruvu, Chittoor - APPCB	12/11/2025 17:00	13.20488	79.097889	PM10	36	210	113
India	Andhra_Pradesh	Kadapa	Yerramukkapalli, Kadapa - APPCB	12/11/2025 17:00	14.465052	78.824187	PM10	69	73	69
India	Andhra_Pradesh	Kadapa	Yerramukkapalli, Kadapa - APPCB	12/11/2025 17:00	14.465052	78.824187	NH3	3	5	3
India	Andhra_Pradesh	Rajamahendravaram	Anand Kala Kshetram, Rajamahendravaram - APPCB	12/11/2025 17:00	16.9872867	81.7363176	NH3	3	5	4
India	Andhra_Pradesh	Rajamahendravaram	Anand Kala Kshetram, Rajamahendravaram - APPCB	12/11/2025 17:00	16.9872867	81.7363176	CO	24	46	31
India	Andhra_Pradesh	Rajamahendravaram	Anand Kala Kshetram, Rajamahendravaram - APPCB	12/11/2025 17:00	16.9872867	81.7363176	OZONE	4	28	22
India	Bihar	Muzaffarpur	Buddha Colony, Muzaffarpur - BSPCB	12/11/2025 17:00	26.11442	85.39813	PM2.5	86	303	190
India	Bihar	Muzaffarpur	Muzaffarpur Collectorate, Muzaffarpur - BSPCB	12/11/2025 17:00	26.1209	85.3647	PM2.5	78	113	103
India	Bihar	Muzaffarpur	Muzaffarpur Collectorate, Muzaffarpur - BSPCB	12/11/2025 17:00	26.1209	85.3647	NO2	9	15	12
India	Bihar	Patna	DRM Office Danapur, Patna - BSPCB	12/11/2025 17:00	25.586562	85.043586	NH3	6	19	8
India	Bihar	Patna	DRM Office Danapur, Patna - BSPCB	12/11/2025 17:00	25.586562	85.043586	OZONE	7	74	50
India	Bihar	Patna	Govt. High School Shikarpur, Patna - BSPCB	12/11/2025 17:00	25.592539	85.227158	NH3	4	6	5
India	Bihar	Gaya	Collectorate, Gaya - BSPCB	12/11/2025 17:00	24.7955	84.9994	PM2.5	74	205	132
India	Bihar	Gaya	Collectorate, Gaya - BSPCB	12/11/2025 17:00	24.7955	84.9994	OZONE	19	21	20
India	Bihar	Gaya	Kareemganj, Gaya - BSPCB	12/11/2025 17:00	24.792403	84.992416	PM2.5	75	283	148
India	Bihar	Gaya	Kareemganj, Gaya - BSPCB	12/11/2025 17:00	24.792403	84.992416	CO	28	44	43
India	Bihar	Hajipur	Industrial Area, Hajipur - BSPCB	12/11/2025 17:00	25.697189	85.2459	NO2	28	65	41
India	Bihar	Katihar	Mirchaibari, Katihar - BSPCB	12/11/2025 17:00	25.560083	87.553265	PM10	62	107	79
India	Bihar	Arrah	New DM Office, Arrah - BSPCB	12/11/2025 17:00	25.5626095	84.663264	OZONE	3	68	16
India	Bihar	Bettiah	Kamalnath Nagar, Bettiah - BSPCB	12/11/2025 17:00	26.80365	84.51954	PM10	42	167	114
India	Bihar	Bhagalpur	DM Office_Kachari Chowk, Bhagalpur - BSPCB	12/11/2025 17:00	25.251013	86.989001	PM2.5	52	311	150
India	Bihar	Bhagalpur	DM Office_Kachari Chowk, Bhagalpur - BSPCB	12/11/2025 17:00	25.251013	86.989001	NO2	6	9	8
India	Bihar	Bhagalpur	DM Office_Kachari Chowk, Bhagalpur - BSPCB	12/11/2025 17:00	25.251013	86.989001	OZONE	12	30	17
India	Bihar	Kishanganj	SDM Office_Khagra, Kishanganj - BSPCB	12/11/2025 17:00	26.0881305	87.93840336	SO2	6	7	7
India	Bihar	Manguraha	Forest Rest House, Manguraha - BSPCB	12/11/2025 17:00	27.308328	84.531742	NO2	3	10	5
India	Bihar	Motihari	Gandak Colony, Motihari - BSPCB	12/11/2025 17:00	26.63086	84.90051	PM10	NA	NA	NA



Dashboard • Last saved: Today at 2:50 PM

country	state	city	station	last_update	latitude	longitude	pollutant_id	pollutant_min	pollutant_max	pollutant_avg
India	Maharashtra	Mumbai	Navy Nagar-Colaba, Mumbai - IITM	12/11/2025 5:00:00 PM	18.897756	72.81332	SO2	16	107	36
India	Maharashtra	Mumbai	Navy Nagar-Colaba, Mumbai - IITM	12/11/2025 5:00:00 PM	18.897756	72.81332	OZONE	8	21	16
India	Maharashtra	Mumbai	Powai, Mumbai - MPCB	12/11/2025 5:00:00 PM	19.1375	72.915056	PM2.5	74	166	108
India	Maharashtra	Mumbai	Powai, Mumbai - MPCB	12/11/2025 5:00:00 PM	19.1375	72.915056	NH3	1	2	2
India	Maharashtra	Mumbai	Sewri, Mumbai - BMC	12/11/2025 5:00:00 PM	19.000084	72.85673	PM10	20	116	72
India	Maharashtra	Mumbai	Sewri, Mumbai - BMC	12/11/2025 5:00:00 PM	19.000084	72.85673	SO2	15	115	66
India	Maharashtra	Mumbai	Shivaji Nagar, Mumbai - BMC	12/11/2025 5:00:00 PM	19.060498	72.923356	PM2.5	93	195	142
India	Maharashtra	Mumbai	Shivaji Nagar, Mumbai - BMC	12/11/2025 5:00:00 PM	19.060498	72.923356	NO2	19	78	41
India	Maharashtra	Mumbai	Kandivali East, Mumbai - MPCB	12/11/2025 5:00:00 PM	19.2058	72.8682	CO	11	39	26
India	Maharashtra	Mumbai	Kandivali West, Mumbai - BMC	12/11/2025 5:00:00 PM	19.215859	72.831718	NO2	14	63	26
India	Maharashtra	Mumbai	Kandivali West, Mumbai - BMC	12/11/2025 5:00:00 PM	19.215859	72.831718	OZONE	7	78	59
India	Maharashtra	Mumbai	Kherwadi_Bandra East, Mumbai - MPCB	12/11/2025 5:00:00 PM	19.0632143	72.8456324	SO2	3	3	3
India	Maharashtra	Mumbai	Khindipada-Bhandup West, Mumbai - IITM	12/11/2025 5:00:00 PM	19.1653323	72.922099	OZONE	19	103	79
India	Maharashtra	Mumbai	Kurla, Mumbai - MPCB	12/11/2025 5:00:00 PM	19.0863	72.8888	SO2	36	37	37
India	Maharashtra	Mumbai	Malad West, Mumbai - IITM	12/11/2025 5:00:00 PM	19.19709	72.82204	PM2.5	49	139	88
India	Maharashtra	Mumbai	Malad West, Mumbai - IITM	12/11/2025 5:00:00 PM	19.19709	72.82204	NO2	39	120	78
India	Maharashtra	Mumbai	Mazgaon, Mumbai - IITM	12/11/2025 5:00:00 PM	18.96702	72.84214	PM2.5	94	184	146
India	Maharashtra	Mumbai	Mindspace-Malad West, Mumbai - MPCB	12/11/2025 5:00:00 PM	19.1878657	72.8304069	NO2	18	80	38
India	Maharashtra	Mumbai	Navy Nagar-Colaba, Mumbai - IITM	12/11/2025 5:00:00 PM	18.897756	72.81332	PM10	95	142	124
India	Maharashtra	Mumbai	Bandra Kurla Complex, Mumbai - IITM	12/11/2025 5:00:00 PM	19.053536	72.84643	OZONE	6	105	38
India	Maharashtra	Mumbai	Colaba, Mumbai - MPCB	12/11/2025 5:00:00 PM	18.91	72.82	NH3	3	3	3
India	Maharashtra	Mumbai	Ghatkopar, Mumbai - BMC	12/11/2025 5:00:00 PM	19.083694	72.920967	PM10	112	246	171
India	Maharashtra	Mumbai	Sion, Mumbai - MPCB	12/11/2025 5:00:00 PM	19.047	72.8746	NO2	6	9	7
India	Maharashtra	Mumbai	Vile Parle West, Mumbai - MPCB	12/11/2025 5:00:00 PM	19.10861	72.83622	SO2	11	59	48
India	Maharashtra	Mumbai	Worli, Mumbai - MPCB	12/11/2025 5:00:00 PM	18.9936162	72.8128113	PM2.5	66	75	69
India	Maharashtra	Mumbai	Worli, Mumbai - MPCB	12/11/2025 5:00:00 PM	18.9936162	72.8128113	NH3	1	2	1
India	Maharashtra	Mumbai	Chakala-Andheri East, Mumbai - IITM	12/11/2025 5:00:00 PM	19.11074	72.86084	PM10	73	139	117
India	Maharashtra	Mumbai	Chakala-Andheri East, Mumbai - IITM	12/11/2025 5:00:00 PM	19.11074	72.86084	SO2	4	19	12
India	Maharashtra	Mumbai	Bandra Kurla Complex, Mumbai - MPCB	12/11/2025 5:00:00 PM	19.065931	72.862131	OZONE	2	109	60
India	Maharashtra	Mumbai	Byculla, Mumbai - BMC	12/11/2025 5:00:00 PM	18.9767	72.838	NH3	9	18	13
India	Maharashtra	Mumbai	Byculla, Mumbai - BMC	12/11/2025 5:00:00 PM	18.9767	72.838	SO2	4	16	14
India	Maharashtra	Mumbai	Byculla, Mumbai - BMC	12/11/2025 5:00:00 PM	18.9767	72.838	CO	36	77	50

Table: air quality (3,189 rows)

6. Conclusion

- Major metropolitan regions exhibit significantly higher pollution levels.
- Particulate matter (PM10 and PM2.5) is the dominant contributor to air pollution.
- Pollution levels vary widely across cities, indicating uneven pollution control effectiveness.
- Interactive dashboards provide an efficient way to analyze and communicate complex environmental data.

7. Future Scope

- **Time-Series Analysis:** Incorporate year-wise or monthly data to study seasonal pollution trends.
- **Health Impact Correlation:** Link pollution data with hospital or health records.
- **Predictive Modeling:** Use machine learning to forecast pollution levels.
- **Geospatial Mapping:** Integrate maps for spatial visualization of pollution hotspots.
- **Policy Evaluation:** Assess the effectiveness of pollution control policies over time.