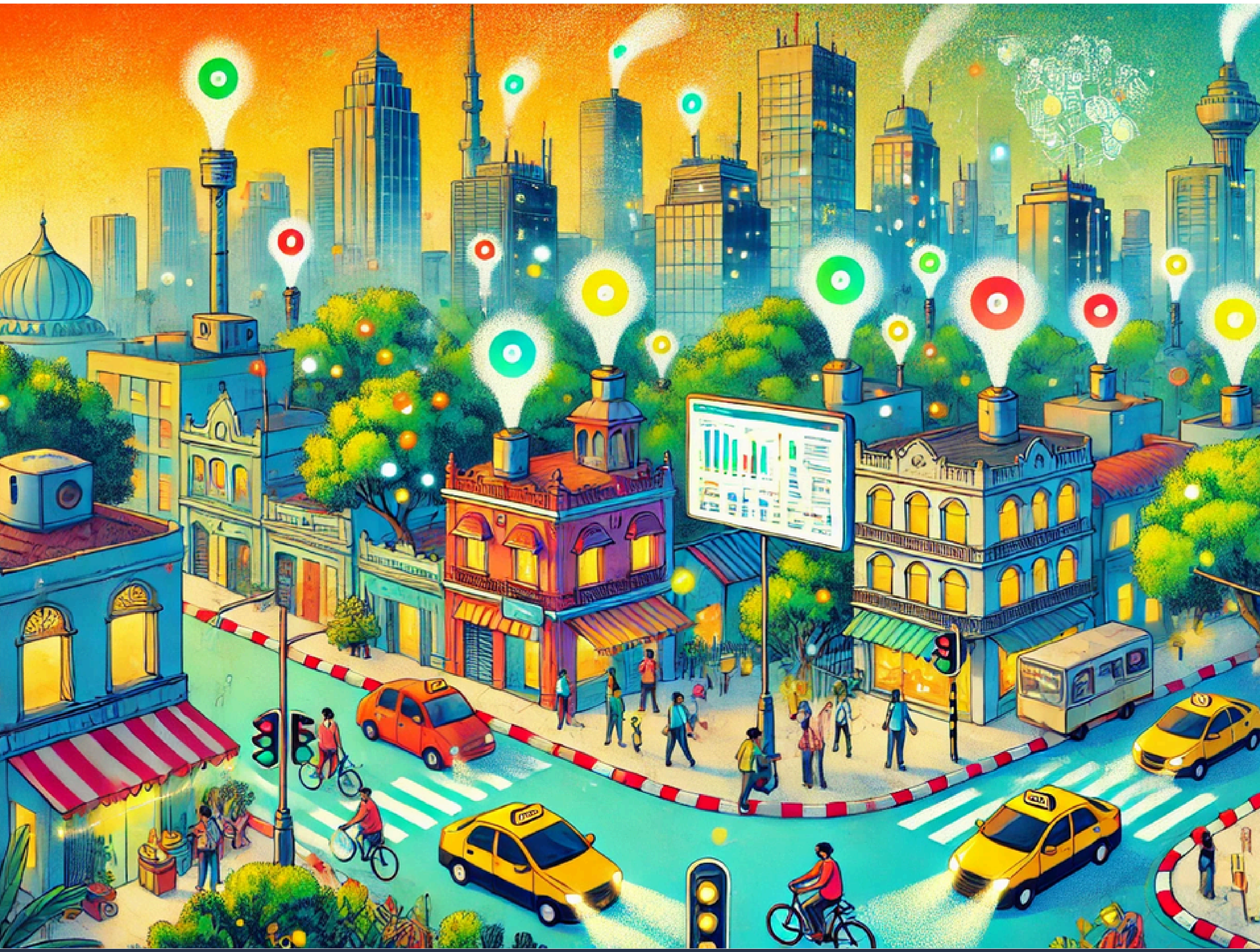
DECEMBER 2024

Decoding Urban Air

HYPERLOCAL INSIGHTS INTO PM2.5 POLLUTION ACROSS INDIAN CITIES



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Executive Summary

"Hyperlocal air quality monitoring is a game-changer for urban India. It bridges the gaps left by traditional monitoring systems, offering real-time, street-level insights into pollution patterns. This granularity empowers policymakers, urban planners, and citizens alike to take targeted, informed actions—whether it's designing low-emission zones, mitigating hotspots, or adopting cleaner technologies. In the fight against air pollution, hyperlocal monitoring is not just a tool; it's a necessity for healthier and more sustainable cities."

RONAK SUTARIA, FOUNDER & CEO, RESPIRER LIVING SCIENCES

This report provides a detailed analysis of PM2.5 pollution levels across ten major Indian cities during November 2024, leveraging data from the Google Maps Air Quality API, part of Google AirView+, and the AtlasAQ platform by Respirer Living Sciences. These technologies enable hyperlocal air quality monitoring, offering unprecedented granularity in understanding pollution patterns. The integration of traditional CPCB data with hyperlocal insights from AirView+ has allowed for the identification of critical pollution hotspots, informed comparisons, and actionable recommendations.

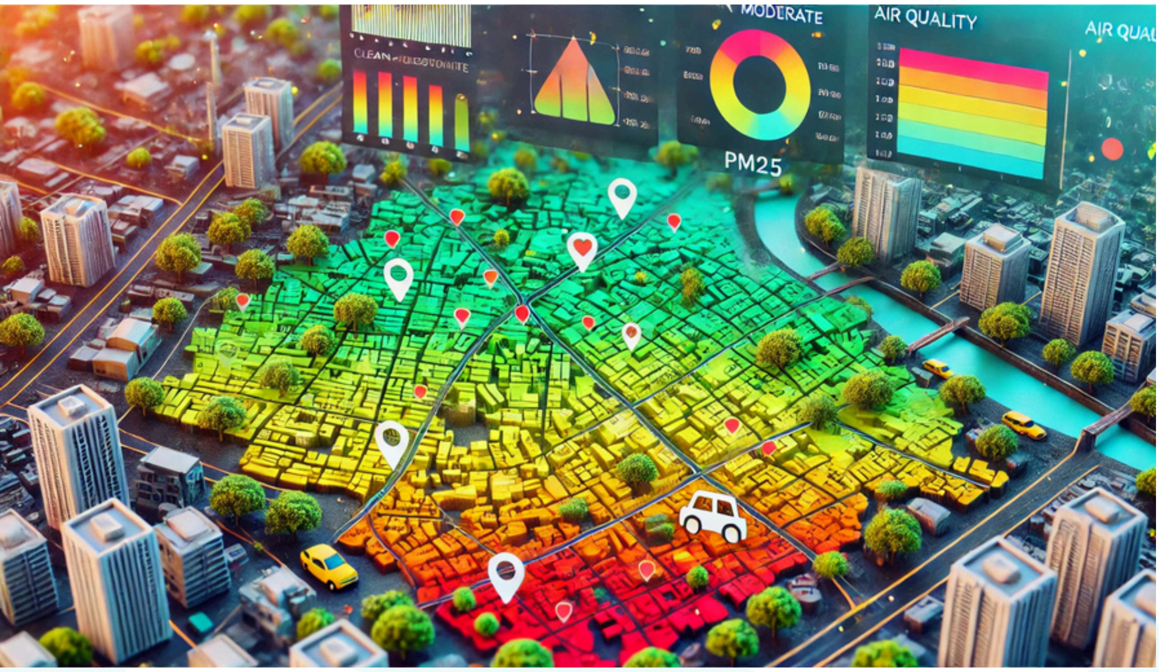
Key Findings

1. **Cities with Highest Pollution**: Delhi emerged as the most polluted city, with several monitoring locations exceeding PM2.5 levels of 300 µg/m^3, far beyond safe limits. Areas like Anand Vihar, Jahangirpuri, and Bawana were identified as critical hotspots due to high industrial emissions and vehicular density.
2. **Cities with Moderate Pollution**: Kolkata and Patna displayed mixed pollution levels, with hotspots like Sealdah (132.3 µg/m^3) and Samanpura (179.4 µg/m^3). Seasonal factors like winter stagnation and crop residue burning significantly contributed to these levels.
3. **Cities with Lower Pollution**: Southern cities like Bengaluru and Chennai consistently recorded the cleanest air, with PM2.5 levels often below 50 µg/m^3 in areas like Velachery and BTM Layout. Contributing factors include robust green cover, effective zoning, and lower industrial pollution.
4. **Regional Hotspots and Variability**: Hyperlocal data revealed additional pollution hotspots, including congested traffic zones, construction-heavy areas, and under-monitored industrial sites. These findings highlight the limitations of traditional monitoring and the critical value of hyperlocal approaches.

Introduction

The Urgency of Air Pollution in Indian Cities

Air pollution remains a persistent issue in India, particularly in urban centres where industrial activities, vehicular emissions, and construction dominate. Among various pollutants, PM2.5—particulate matter less than 2.5 microns in diameter—is a leading contributor to respiratory and cardiovascular illnesses, with severe implications for public health. As India urbanises rapidly, monitoring PM2.5 levels becomes crucial to safeguarding the well-being of its citizens.



Objectives

The aim of this report is to:

1. Highlight pollution trends across ten major cities in India using hyperlocal monitoring techniques from November 1 - 30, 2024.
2. Assess the role of innovative platforms like Google AirView+ and AtlasAQ in generating actionable insights.
3. Compare localised data from Google Maps Air Quality API with CPCB monitoring stations to identify hotspots.

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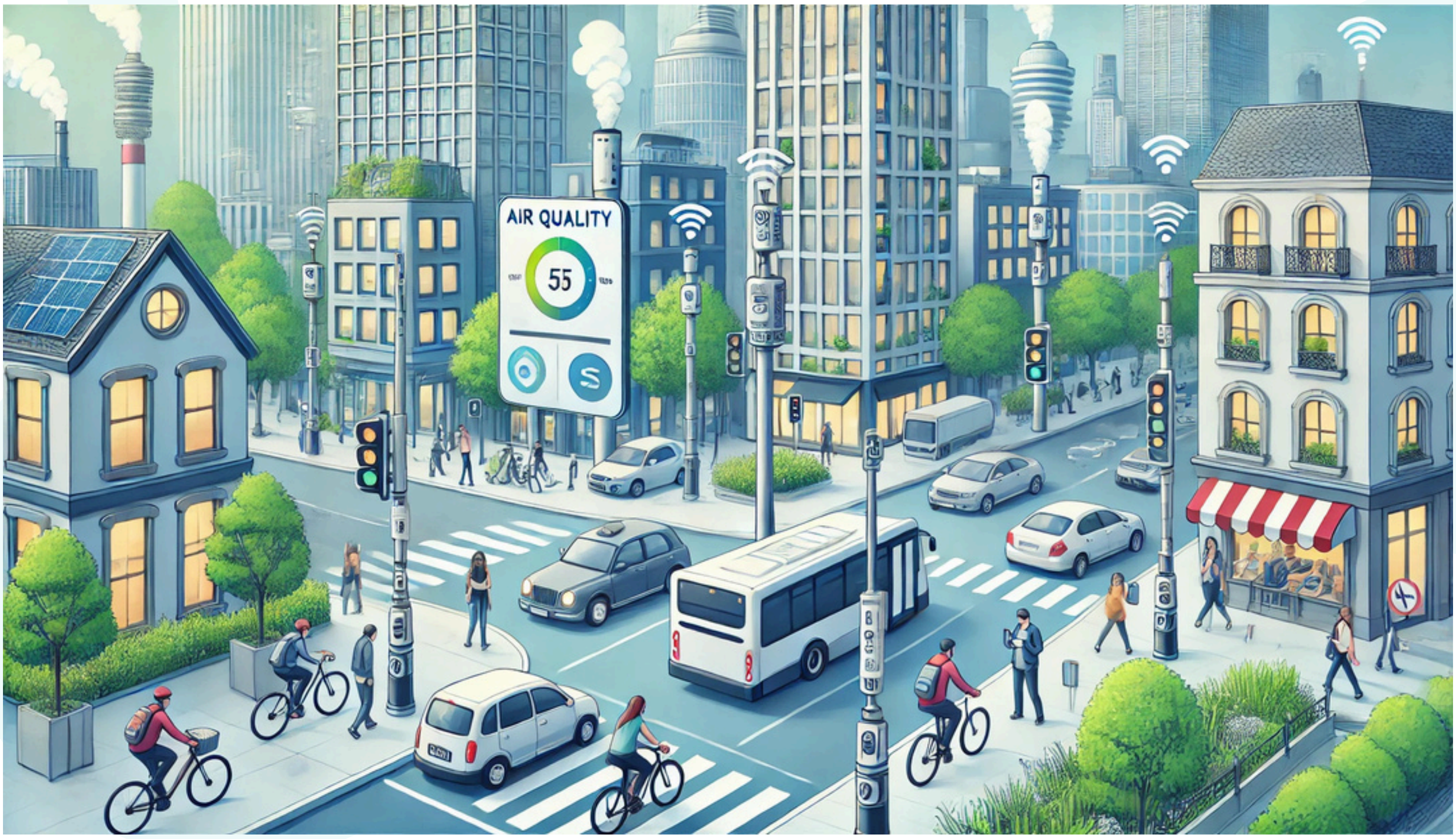
Methodology

The analysis utilised two distinct data sources: CPCB and Google Maps AQ. These sources differ in methodology and coverage. CPCB relies on a fixed network of reference-grade monitoring instruments for real-time ground-level data, while Google Maps AQ combines multiple layers, including government networks, commercial sensors, traffic data, satellite imagery, meteorology, and dispersion models.

Google Maps AQ provides data at a 500x500 meter grid, offering granular, wide-scale coverage that complements the localized precision of CPCB stations. This granularity enables the identification of hotspots beyond the reach of government monitoring sites.

The analysis focuses on data at approximately a 3x3 km grid or finer, comparing commonalities and differences in hotspot detection. While some hotspots align with CPCB data, Google Maps AQ uncovers significant additional areas, particularly where CPCB stations are absent.

Each city summary highlights these overlaps and discrepancies, emphasizing the advantages of granular hyperlocal data in capturing a more comprehensive pollution profile.



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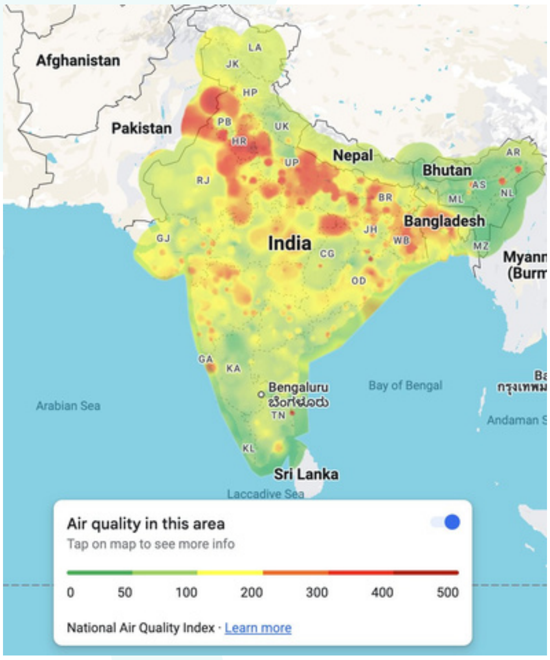
Overview of Hyperlocal Polluted Hotspots

Unveiling the Invisible: Pinpointing Pollution Hotspots Across Urban India with Hyperlocal Insights

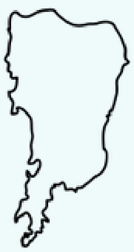


Across India, the integration of hyperlocal monitoring has revealed critical pollution hotspots that are often overlooked by traditional monitoring systems. By overlaying data from CPCB monitoring stations with hyperlocal insights from Google Maps AQ, it becomes evident that air pollution is highly localised and influenced by unique regional factors. This granular data highlights hotspots in congested areas, industrial zones, and under-regulated spaces, where residents face significantly higher exposure to PM2.5 levels than citywide averages suggest.

New Delhi

- **Hotspots Identified:** Anand Vihar, Jahangirpuri, Bawana.
- **Factors:** Industrial emissions, traffic congestion, crop residue burning during winter.
- **Impact:** PM2.5 levels exceeding 300 μg/m^3, far above national standards.

Mumbai



- **Hotspots Identified:** Shivaji Nagar (Chembur), Kandivali, Deonar.
- **Factors:** Construction dust, vehicular emissions, waste processing sites.
- **Impact:** Moderate PM2.5 levels, with some zones crossing 100 μg/m^3.

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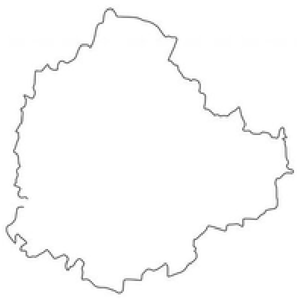
Kolkata

- **Hotspots Identified:** Sealdah, Dhapa, Ballygunge.
- **Factors:** Proximity to industrial zones and outdated transport infrastructure.
- **Impact:** PM2.5 levels peaking around 130 µg/m³ in certain areas.

Bengaluru

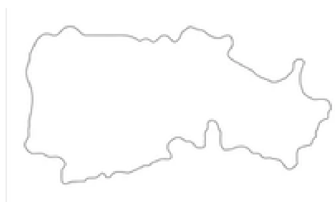


- **Hotspots Identified**: Peenya, Silk Board Junction.
- **Factors**: High-density traffic corridors and industrial hubs.
- **Impact**: Relatively lower pollution compared to other cities but with localized spikes.

Chennai

- **Hotspots Identified**: Manali, Velachery Res. Area.
- **Factors:** Industrial activities and occasional stagnant weather conditions.
- **Impact:** Generally clean air but with pockets of concern.

Patna



- **Hotspots Identified**: Samanpura, Rajbansi Nagar.
- **Factors**: Crop residue burning in the surrounding regions and urban expansion.
- **Impact:** Consistently high PM2.5 levels exceeding 170 µg/m³ in peak zones.

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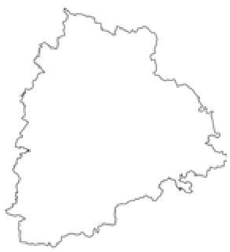
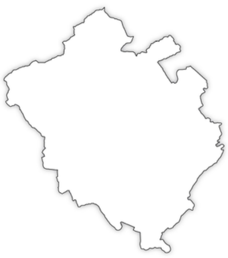
Unveiling the Invisible: Pinpointing Pollution Hotspots Across Urban India with Hyperlocal Insights

Hyderabad



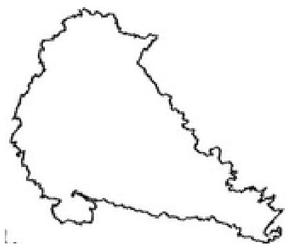
- **Hotspots Identified:** Sanathnagar, Balanagar
- **Factors:** Proximity to industrial zones and vehicular congestion.
- **Impact:** Isolated peaks of poor air quality in otherwise moderate pollution levels.

Chandigarh



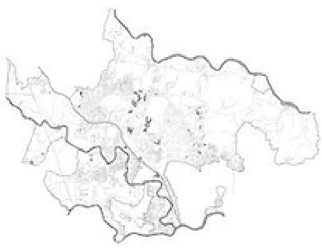
- **Hotspots Identified:** Sector 53, Sector 68
- **Factors:** Urban sprawl and rising vehicular use.
- **Impact:** Sharp PM2.5 spikes in areas away from the city centre.

Pune



- **Hotspots Identified:** Revenue Colony (Shivajinagar), Hadapsar, Transport Nagar-Nigdi.
- **Factors:** Increasing vehicular congestion, urban construction.
- **Impact:** PM2.5 levels between 60–100 μg/m^3 in affected zones.

Pimpri-Chinchwad



- **Hotspots Identified**: Thergaon, Savta Mali Nagar, Gavalinagar.
- **Factors**: Rapid industrialization, insufficient green buffers.
- **Impact**: PM2.5 levels crossing 115 μg/m^3 in key industrial pockets.

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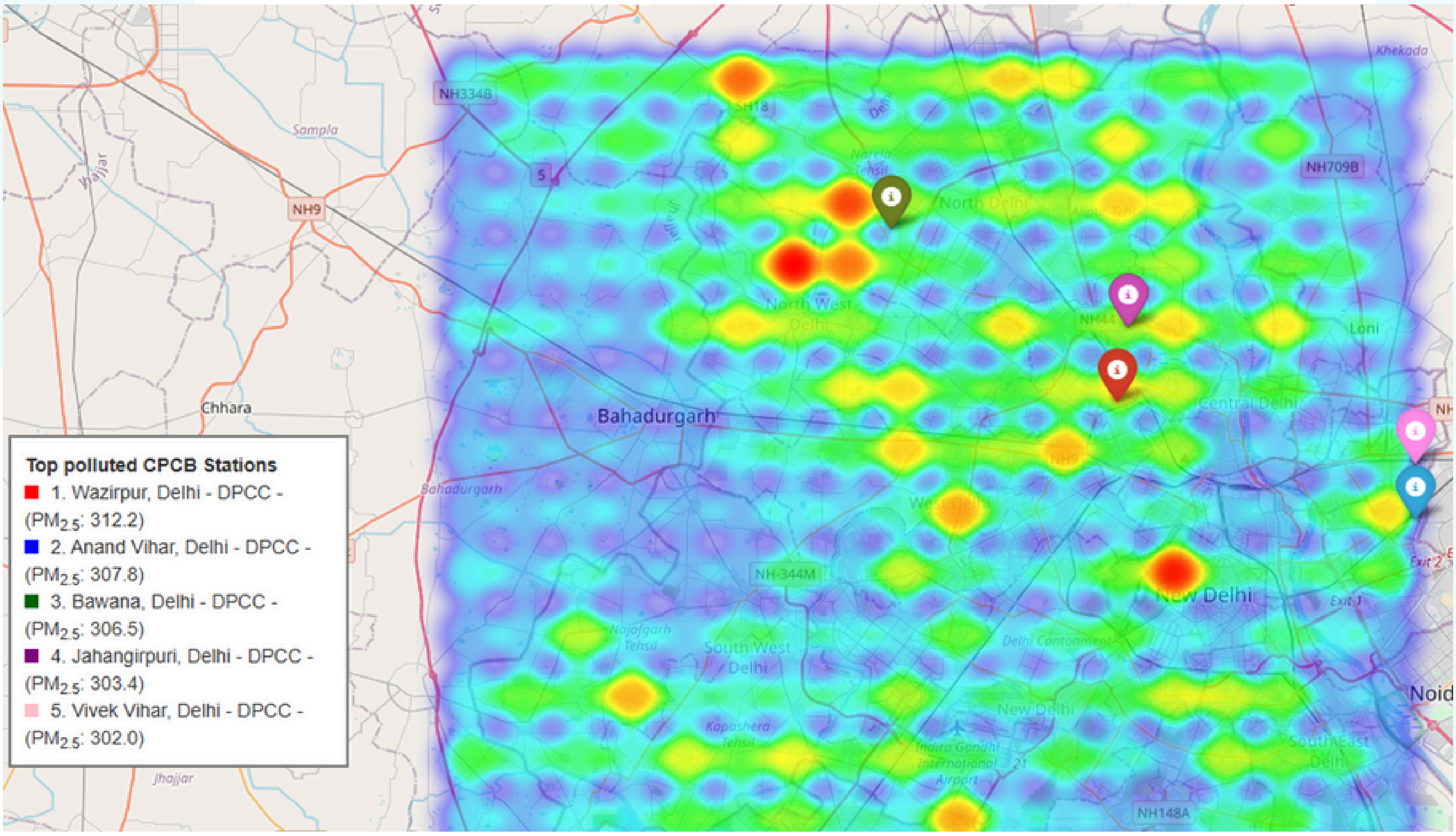
Polluted Hotspots across Cities

NEW DELHI

Delhi with a wide network of government air quality monitors covering the city captures the levels of PM2.5 granularly. This network of 38 monitors reported an average of 248 micrograms per cubic meter of PM2.5 in the month of Nov ‘24.

- Data from the CPCB monitor and Google Maps AQ from **Bavana** show the common location with a high level of PM2.5
- Google Maps AQ data shows the **Chandpur Village,** northwest Delhi as the highest polluted area at 391 micrograms per cubic metre (µg/m3), followed by **President’s Estate** in central Delhi at 385 µg/m3 and **Bavana** at 373 µg/m3
- The granular analysis using Google Maps AQ data also shows the area near the President’s Estate as a hotspot, however, the government monitoring network does not have this area within the top 5 in Delhi



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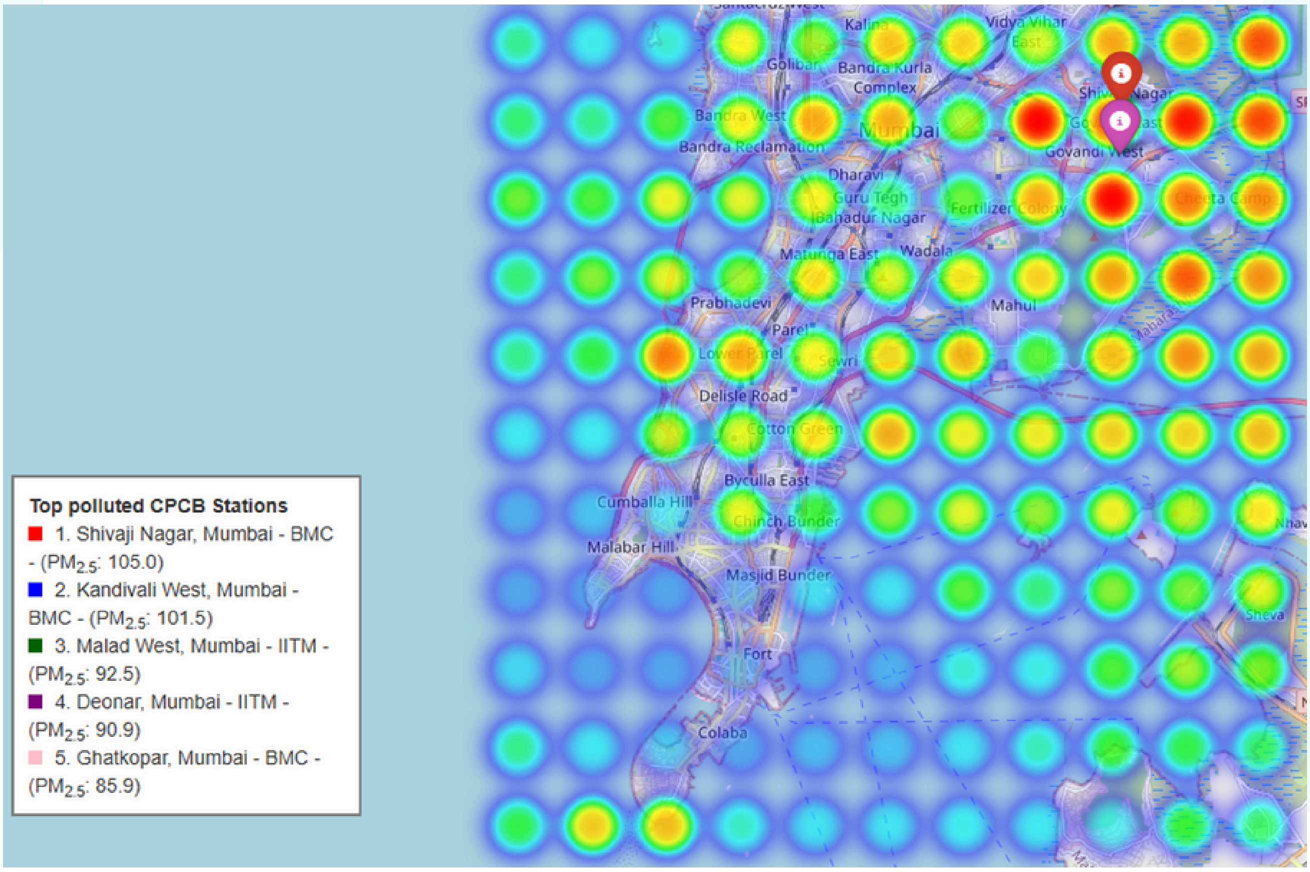
Polluted Hotspots across Cities

MUMBAI

Mumbai had 27 air quality monitors active in Nov '24 and the city reported an average of 66 micrograms per cubic meter for PM2.5.

- The government monitoring network and the Google Maps AQ data show a good overlap in the identification of the hotspots.
- **Shivajinagar** (**Chembur**), **Kandivali Wes**t, and **Malad West** ranked among the top 3 in Mumbai
- The areas near the vicinity of **Chembur, Anushakti Nagar,** and **Mankhurd** recorded high pollution when identified using Google Maps data
- The density of hotspots identified using Google Maps AQ data and placement of CPCB monitors have a good overlap in the city of Mumbai, including areas near Lower Parel which are monitored by the CPCB network.



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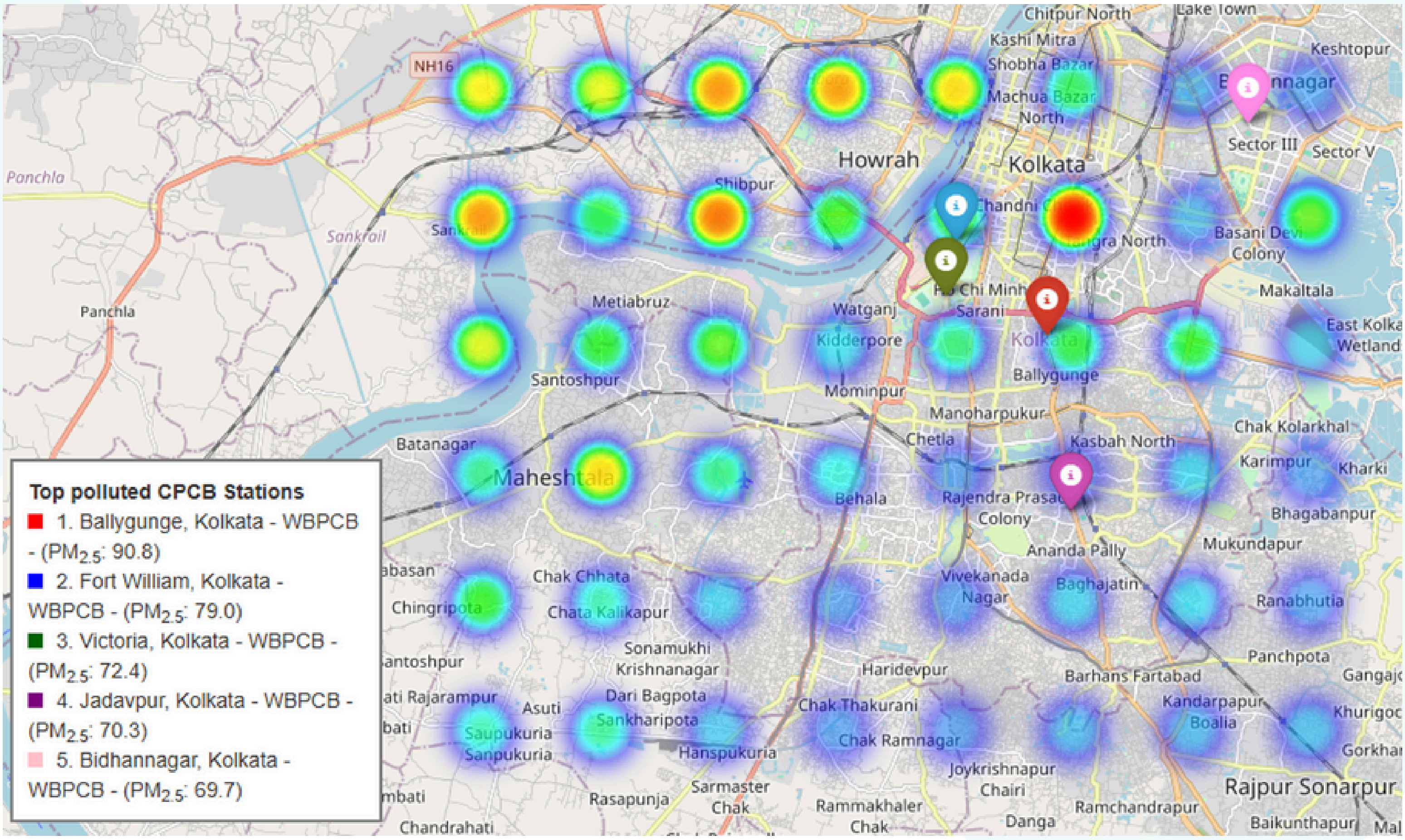
Polluted Hotspots across Cities

KOLKATA

Kolkata has seven air quality monitors in the city and has recorded the levels around 73 micrograms per cubic meter in Nov ‘24.

- The government monitors have been strategically placed to monitor the city pollution with the top three monitors recording the data near **Sealdah**
- The Google Maps AQ data also shows high levels recorded in **Sealdah**
- The other hotspots in the city can be captured using more granular approach, as shown in the Google Maps AQ data – **Dhapa** and **Maidan** (**New Market Area**) showing high levels of PM2.5



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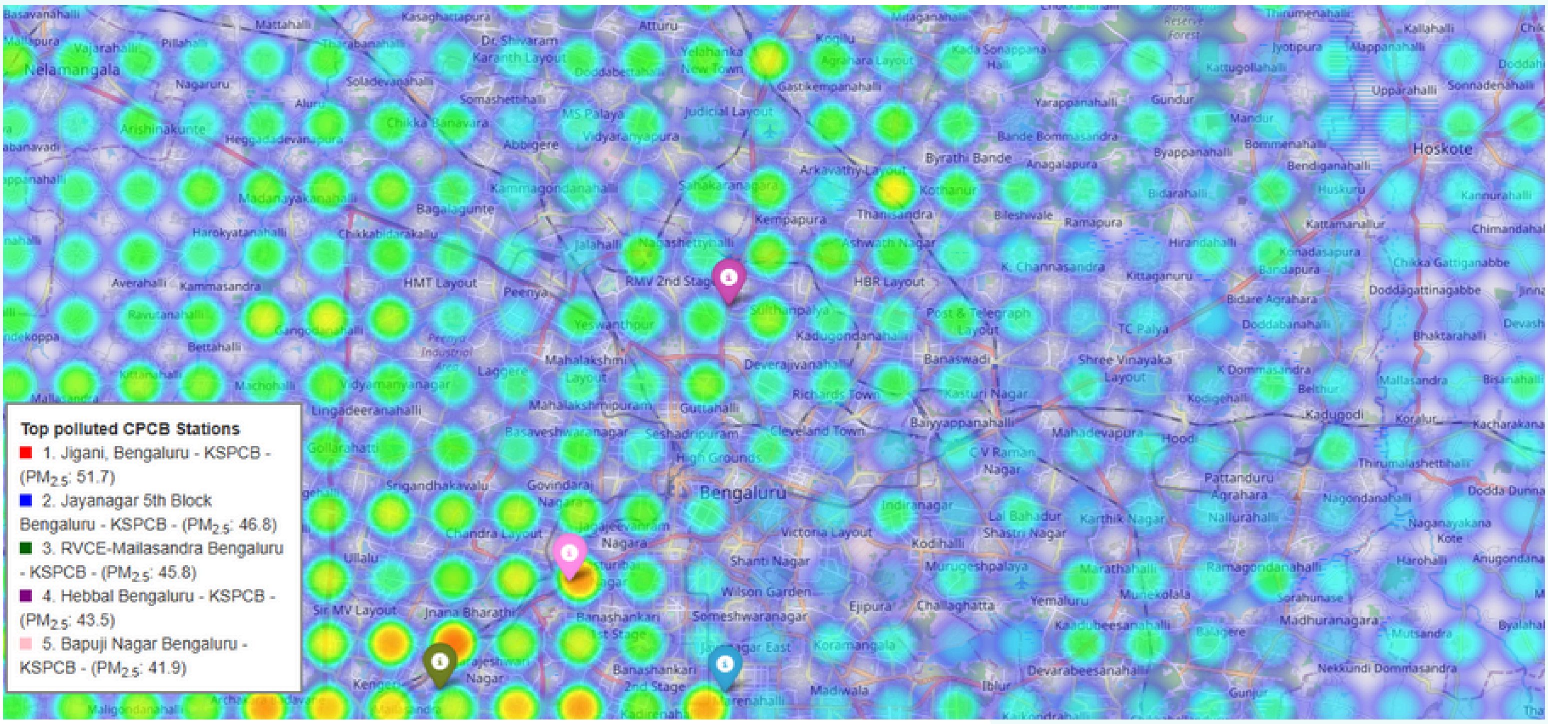
Polluted Hotspots across Cities

BENGALURU

Bengaluru has recorded lower levels of PM2.5 as compared to other metro cities of India. The eleven monitoring sites recorded an average of 39 micrograms per cubic meter in Nov '24.

- The hotspots in the city according to the government monitoring sites are **Jigani, Jayanagar**, and **Mailasandra**
- **Jigani** monitoring site primarily representing industrial activity has recorded the highest pollution even in the Google Maps AQ data
- Among other hotspots seen using the Google Maps AQ data are **Ragihalli** and **Badamanavarathekaval**, however, the levels remain within the 60 micrograms per cubic meter threshold



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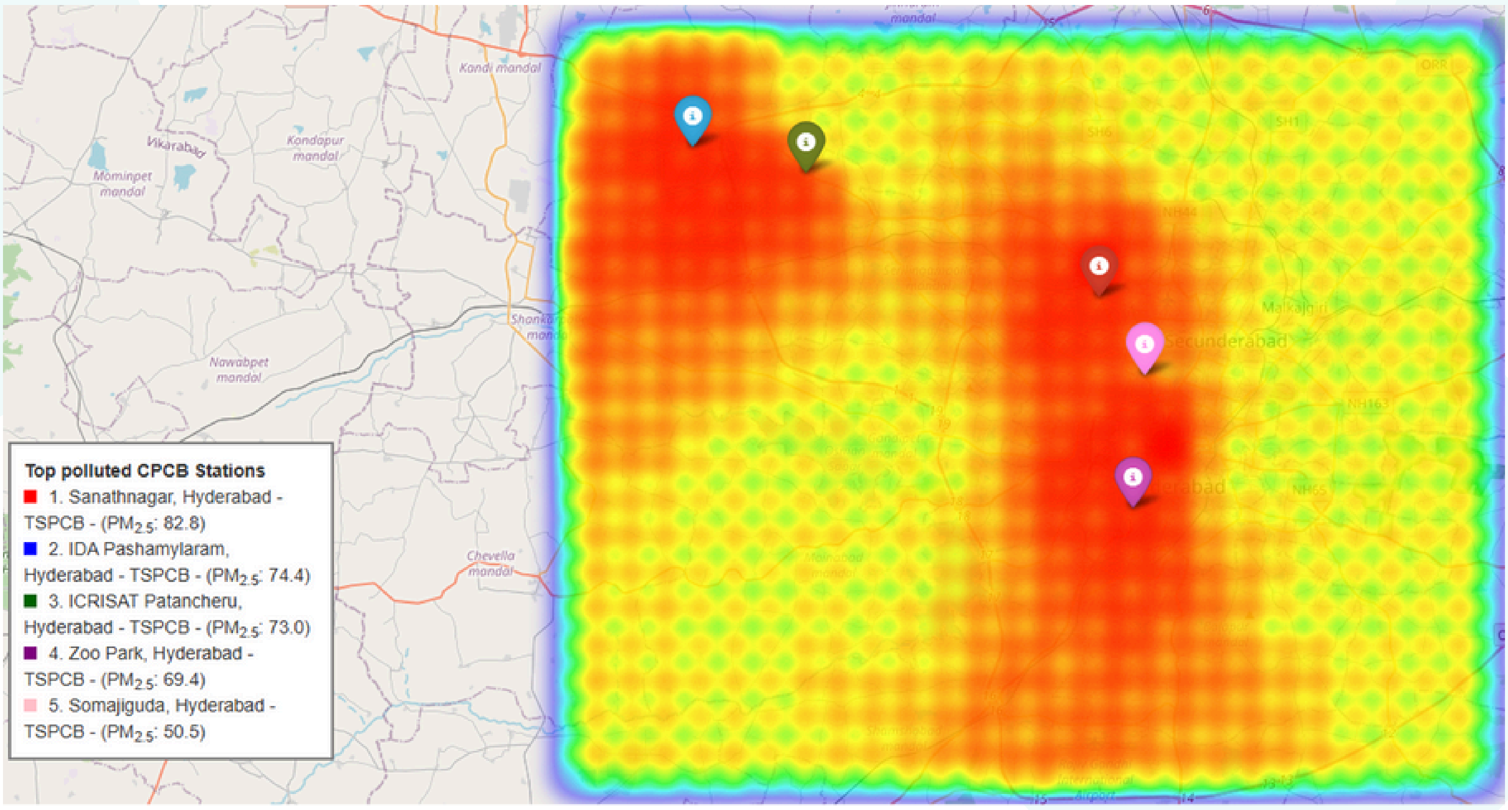
Polluted Hotspots across Cities

HYDERABAD

Hyderabad has 14 monitoring sites in the city and recorded an average of 48 micrograms per cubic meter in Nov '24.

- The top five most polluting locations in Hyderabad overlap with those of the hotspots or high pollution areas identified using the Google Maps AQ data - **Balanagar, Nampally** and **Nandigaon** were identified as hotspots.
- The city has a wide network that covers the appropriate monitoring of the city
- -Google Maps AQ data shows hotspots scattered in the city centre and in the areas of Pashamylaram and Patancheru where there are apt government monitoring sites



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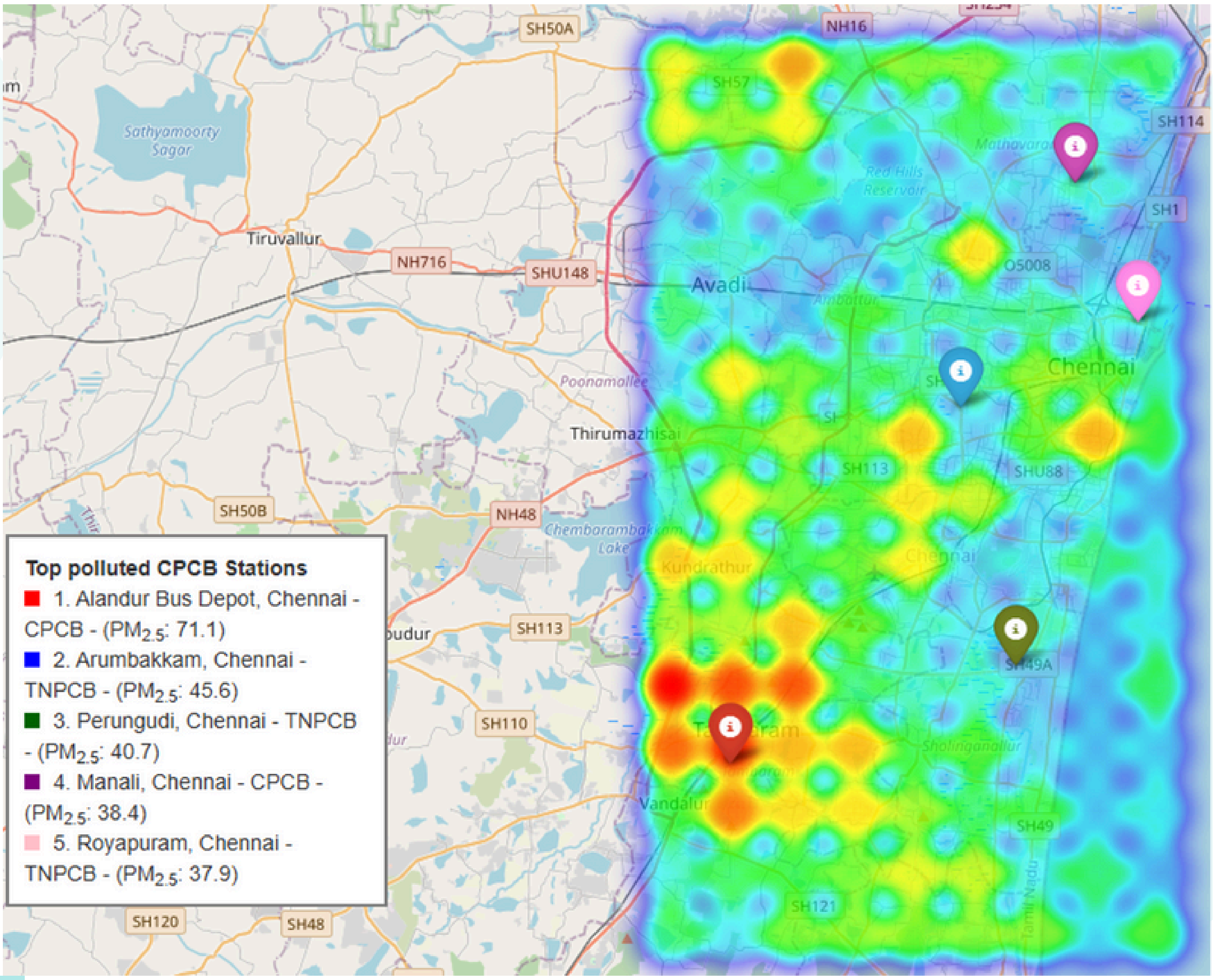
Polluted Hotspots across Cities

CHENNAI

Chennai recorded an average of 40 micrograms per cubic meter in Nov ‘24 as per the data from 8 monitoring stations in the city.

- The government monitor at Alandur Bus Depot recorded the highest pollution levels and was also among the hotspots identified by the Google Maps AQ data
- Other hotspots from the Google Maps AQ data are in the areas of **Varadharajapuram, Irumbuliyur**, and **Ankaputhur**
- There are additional hotspots identified by the Google Maps AQ data, mainly in the city centre and towards the areas of Triplicane and Upparipalayam



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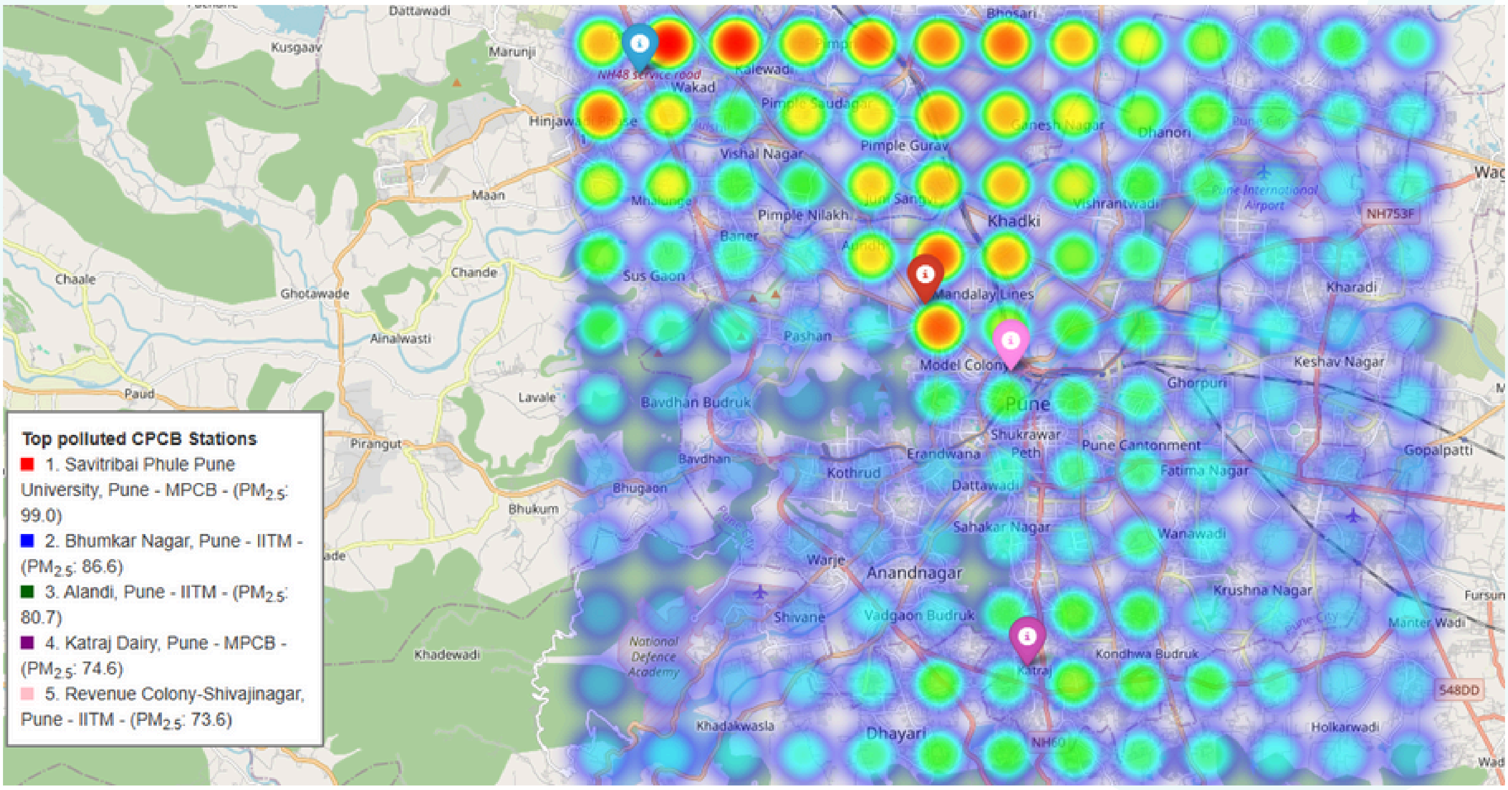
Polluted Hotspots across Cities

PUNE

The city of Pune recorded PM2.5 levels of 67 micrograms per cubic meter which is above the threshold of 60 using the 10 government monitors that recorded data in Nov '24

- The top location at Savitribai Phule Pune University recorded the highest pollution and is a common location in both the data sources- CPCB and Google Maps AQ
- -Similarly, the **Bumkar Chowk** location was also among the common hotspots identified by both data sources
- Additionally, **Gokhlenagar** and **Khadki** were among other hotspots identified using the Google Maps AQ data

Overall, there is a significant overlap between the hotspots identified using the CPCB network and the Google Maps AQ data

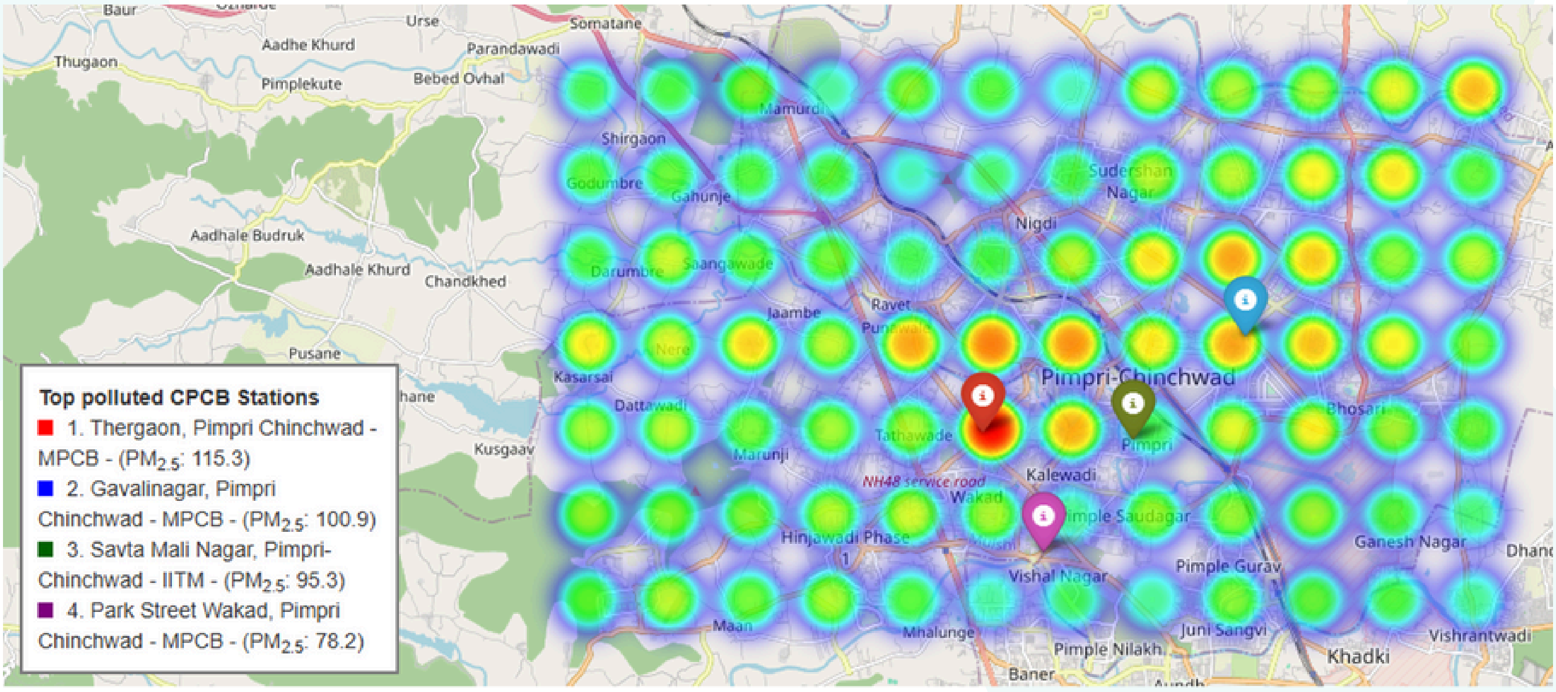


Polluted Hotspots across Cities

PIMPRI CHINCHWAD

Pimpri-Chinchwad has four monitoring sites and the average of PM2.5 recorded in Nov ‘24 was well above the threshold of 60 micrograms per cubic meter. The CPCB network recorded an average of 97 in Nov ‘24

- The top location was **Thergaon**, with the PM2.5 levels of 115 from the CPCB data
- The same location is also a hotspot according to the Google Maps AQ data
- Additionally, the **area around MIDC** was identified as a hotspot using the Google Maps AQ data with Gavalinagar (CPCB) monitor capturing the pollution levels



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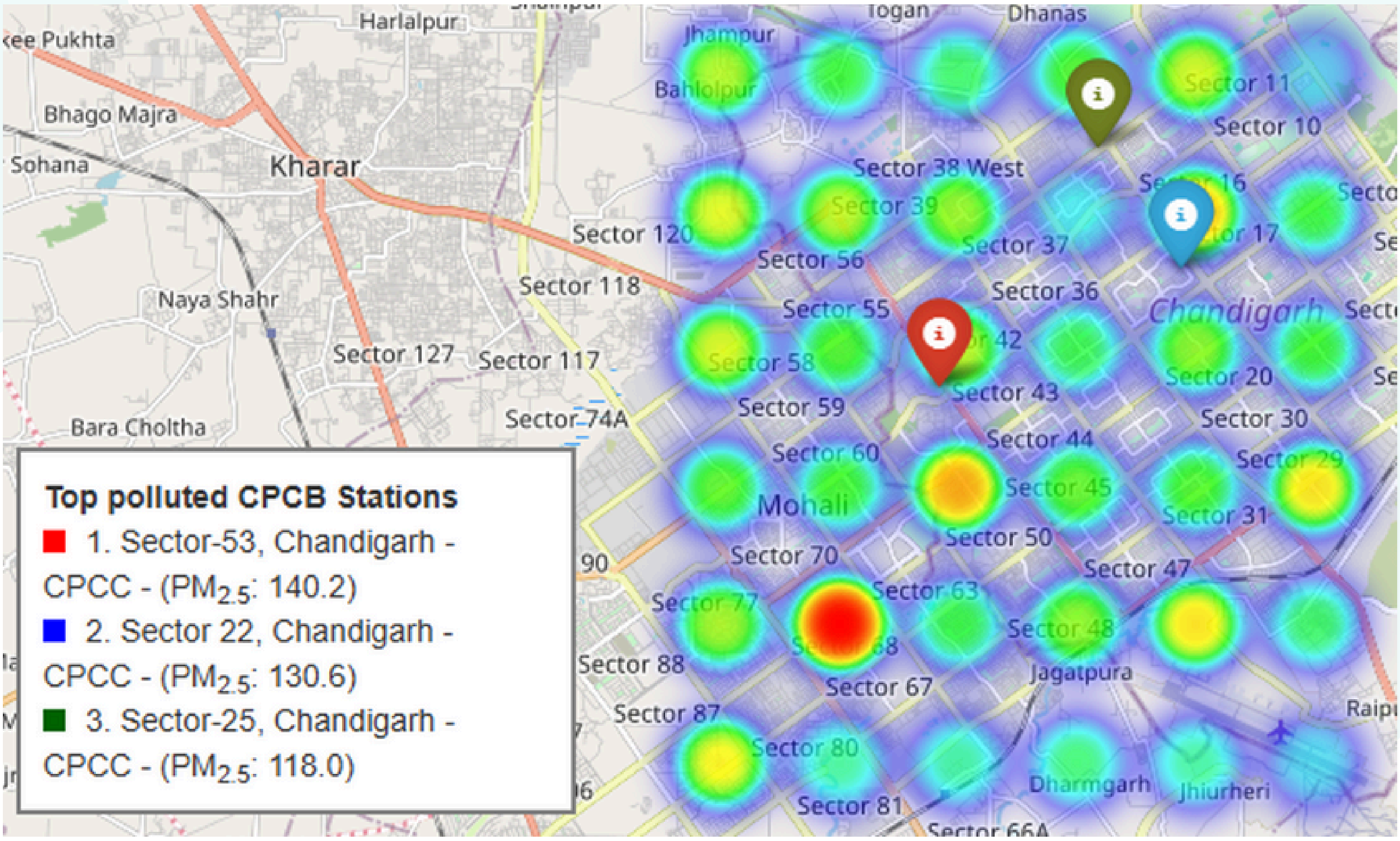
Polluted Hotspots across Cities

CHANDIGARH

Three government monitors in Chandigarh recorded PM2.5 levels of 129 micrograms per cubic meter in Nov ‘24

- While there is some overlap between the placement of government monitors and the hotspots identified using the Google Maps AQ data, there are certain hotspots that are not covered by the network
- **Sector 53** was the top polluted location followed by Sector 22, according to the CPCB data
- **Sector 68** was identified as the hotspot using the Google Maps AQ data is near the Chandigarh border and there is no monitoring site within the area
- **Sector 22, Sector 51,** and **Sector 47** (near the Airport area) are the other hotspots identified using the Google Maps AQ data



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Significance of Hotspot Monitoring

"Hyperlocal air quality monitoring can support municipalities to act with precision. It provides real-time insights into pollution hotspots, helping us design targeted interventions to ensure public health is safeguarded at the neighbourhood level.."

Shri Shekhar Singh, Commissioner, Pimpri Chinchwad Municipal Corporation

Hotspot monitoring is vital for pinpointing localised pollution sources and enabling targeted interventions like emission controls, green buffers, and low-emission zones. Unlike regional averages, it identifies high-risk areas, protecting vulnerable populations and guiding policy decisions. Traditional systems like CPCB's monitoring stations provide reliable, location-specific data, while technologies like AtlasAQ enhance this by translating raw data into detailed pollutant maps. Google AirView+, through its hyperlocal 500x500 meter grid, complements this by integrating multiple data sources, including sensors, traffic, and satellite data, to reveal previously unnoticed hotspots.
Together, these technologies provide granular, actionable insights, transforming urban air quality management.

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Recommendations

"Hyperlocal air quality monitoring bridges the gap between traditional broad-scale assessments and the localised realities of air pollution. By providing fine-grained, real-time data, this approach enables us to pinpoint pollution sources with accuracy and design targeted interventions that can improve public health outcomes. It is commendable that organisations such as Respirer are leveraging innovative technologies such as advanced sensors and data analytics to address this urgent need, offering actionable insights towards pollution abatement"

PROFESSOR SACHCHIDA NAND TRIPATHI, CHAIR, STEERING COMMITTEE, NATIONAL CLEAN AIR PROGRAMME (NCAP) AND DEAN, KOTAK SCHOOL OF SUSTAINABILITY, IIT KANPUR

Addressing the challenges of air pollution requires a multi-faceted approach combining policy reforms, urban design innovations, and public engagement. The following recommendations provide actionable steps to mitigate pollution and promote sustainable urban living.

Policy Interventions: Governments must prioritise stricter regulatory measures to curb emissions from major sources, including vehicles and industries. Enforcing compliance with emission standards can significantly reduce the release of harmful pollutants. Additionally, introducing incentives for cleaner alternatives, such as electric vehicles and eco-friendly construction practices, will encourage the transition to sustainable technologies.

Urban Design: Redesigning urban landscapes to include more green belts and urban forestry can act as natural buffers against air pollution, improving air quality while enhancing the aesthetic appeal of cities. Developing pedestrian-friendly zones and implementing low-emission zones in highly congested areas can reduce vehicular pollution and promote cleaner, healthier environments.

Public Awareness: Empowering citizens with information is crucial in the fight against air pollution. Mobile applications and digital platforms can provide real-time air quality data, enabling individuals to make informed decisions about their daily activities. Educational campaigns can further raise awareness about the sources and impacts of air pollution, fostering a culture of environmental responsibility. Public engagement not only enhances individual awareness but also creates a collective drive toward cleaner cities.

Conclusion

Hyperlocal air quality monitoring represents a transformative shift in how urban air pollution is understood and managed. By combining granular insights with traditional monitoring systems, it provides a more comprehensive picture of pollution patterns and their impacts. This approach enables policymakers, urban planners, and communities to act with precision, addressing critical hotspots and implementing targeted interventions.

The integration of innovative technologies like AtlasAQ and Google AirView+ underscores the potential of data-driven strategies to bridge gaps in existing systems. As cities continue to grow and environmental challenges intensify, embracing hyperlocal monitoring is not just a necessity but a cornerstone for building healthier, more sustainable urban environments.

This report highlights the importance of leveraging these advancements to protect public health and create a future where clean air is accessible to all.

About Respirer Living Sciences

Respirer Living Sciences is a leading climate-tech startup in India, dedicated to achieving cleaner air and accelerating the transition to cleaner energy. Established in 2017, Respirer provides scientifically validated, scalable air quality monitoring devices and real-time air pollution analytics platforms. These solutions deliver accurate and actionable data to governments, industries, and citizens, empowering them to address air pollution and methane emissions effectively. Respirer's network includes over 2,500 air quality devices deployed across more than 25 Indian cities and several international locations. The company collaborates with prestigious institutions such as IIT Kanpur and Duke University and is part of the Centre of Excellence ATMAN on Clean Air Technologies, supported by the Government of India. For more details, visit the Respirer

Google has partnered with Respirer Living Sciences on the AirView+ initiative to enhance air quality monitoring across India. By deploying a network of sensors in over 150 cities, Respirer measures pollutants such as PM2.5, PM10, CO2, NO2, ozone, and VOCs. These sensors, strategically placed in locations such as administrative establishments and utility poles, provide real-time data every minute. The collected information is analysed using Google's AI to generate hyperlocal air quality insights, which are accessible to both government agencies and the public through platforms like Google Maps.

For More Granular Data on Hotspots across India, please contact: research@respirer.in