



## Winter pollution crisis in megacities of India: Going beyond Delhi

### Mumbai

*Anumita Roychowdhury and Sharanjeet Kaur*

*Lead research and analysis: Sharanjeet Kaur*

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The growing problem of particulate pollution in Mumbai has once again come into focus this winter. According to a new analysis by the Urban Lab at the Centre for Science and Environment (CSE), Mumbai recorded its lowest winter average PM<sub>2.5</sub> level in four years, with a seasonal average of 49 µg/m<sup>3</sup>—a 24 per cent decline compared to previous winters. This assessment, based on winter PM<sub>2.5</sub> trends from October 1, 2024, to January 31, 2025, highlights both progress and persistent challenges in air quality management across the region.

While the overall seasonal average has improved, the problem of winter pollution remains widespread, affecting both large cities and smaller towns. The highest daily PM<sub>2.5</sub> level this winter was 81 µg/m<sup>3</sup>, marking a 44% decline from past peaks. However, localized pollution spikes remain concerning—MaladW (IITM) recorded the highest daily surge of 194 µg/m<sup>3</sup>. Despite seasonal improvements, winter pollution levels across many locations exceeded annual averages. Deonar emerged as the most polluted area, with a winter average PM<sub>2.5</sub> level of 80 µg/m<sup>3</sup>, followed by Shivaji Nagar at 76 µg/m<sup>3</sup>.

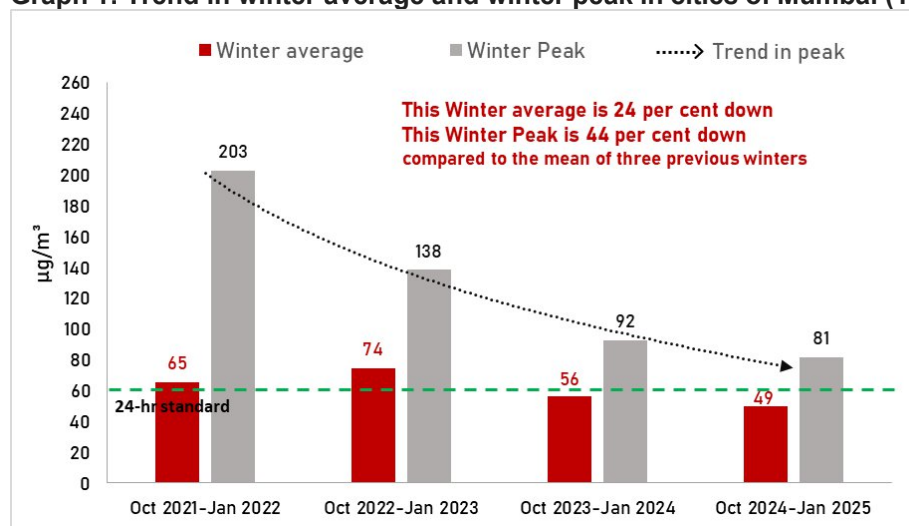
Mumbai also faces a multi-pollutant challenge, with nitrogen dioxide (NO<sub>2</sub>) levels rising significantly between November and January, particularly at Byculla and Bandra-Kurla. Borivali(E) IITM witnessed the highest increase in winter pollution, with PM<sub>2.5</sub> levels surging by 24 per cent compared to the previous year. The interplay of local emissions and regional influences continues to aggravate air quality, challenging the natural ventilation benefits of Mumbai's coastal climate.

Winter pollution typically intensifies in late November and early December, as cooler and calmer conditions trap local emissions. This analysis covers 21 older continuous ambient air quality monitoring stations (CAAQMS) across Mumbai. Although several new real-time monitors have been installed in some cities, they were not included in the long-term assessment due to data consistency requirements. A substantial dataset was processed using the USEPA methodology to ensure accuracy, addressing data gaps to provide a comprehensive understanding of air quality trends.

## Key Findings

**The winter average of PM2.5 levels in Mumbai was the lowest in the past four years:** This winter, the average PM2.5 concentration across the city stood at  $49 \mu\text{g}/\text{m}^3$ , which is 24 per cent lower than the average of the previous three winter seasons (October to January) (See Graph 1: Trend in winter average and winter peak in cities of Mumbai). The highest daily PM2.5 level this winter was recorded on December 28, 2024, at  $81 \mu\text{g}/\text{m}^3$ , marking a 44 per cent decrease from the average of the past three winter peaks. However, amongst stations, the highest daily peak was observed on November 1, 2024, at MaladW (IITM) with a level of  $194 \mu\text{g}/\text{m}^3$ . A total of 21 older monitoring stations across Mumbai were used to assess the winter trends and peaks. The winter period is defined as October 1 to January 31, with the average and peak values calculated from the daily mean of available continuous data since 2021.

**Graph 1: Trend in winter average and winter peak in cities of Mumbai (1 Oct 2024 – 31 Jan 2025)**

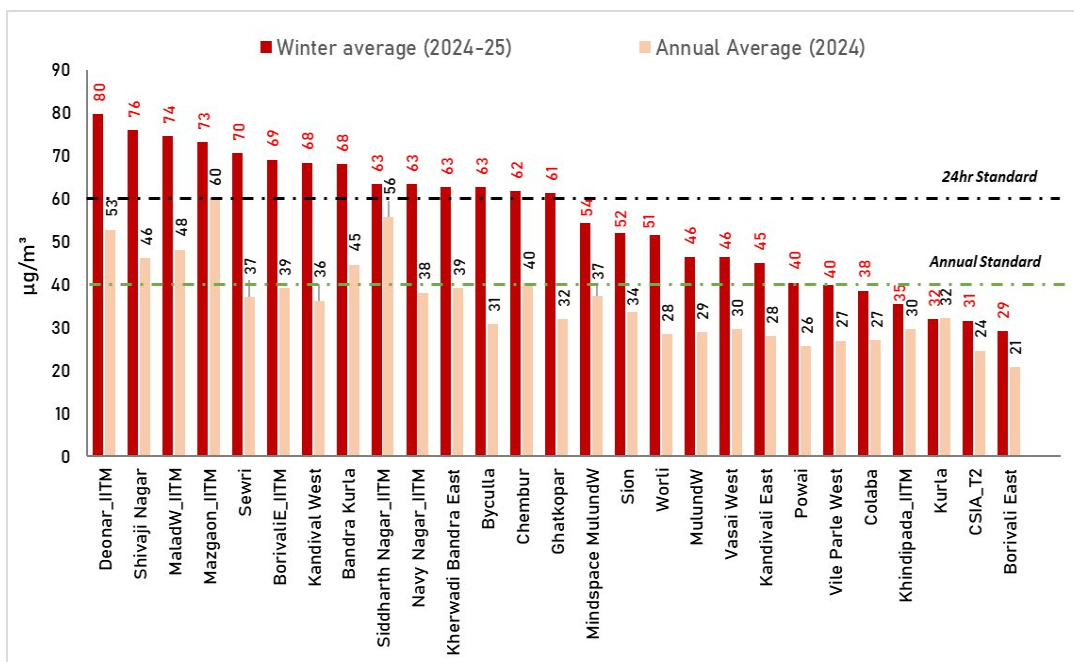


Source: CSE analysis of CPCB real-time data.

**Rising winter PM2.5 levels disrupt annual air quality trends:** Mumbai's air quality deteriorates significantly during winter, with PM concentrations in the 2024-25 winter season rising well above the annual average of 2024 across monitoring stations. The highest winter average was recorded at Deonar, reaching  $80 \mu\text{g}/\text{m}^3$ , compared to its annual average of  $53 \mu\text{g}/\text{m}^3$ . Similarly, Shivaji Nagar and Malad ITM saw sharp increases, with winter levels at  $76 \mu\text{g}/\text{m}^3$  and  $74 \mu\text{g}/\text{m}^3$ , compared to their annual averages of  $46 \mu\text{g}/\text{m}^3$  and  $48 \mu\text{g}/\text{m}^3$ , respectively.

Across most locations, winter pollution levels surged by 12 – 51 per cent above the annual average, indicating a significant seasonal impact. Even at Borivali East, which had the lowest annual average of  $21 \mu\text{g}/\text{m}^3$ , winter levels still increased by 29 per cent to  $29 \mu\text{g}/\text{m}^3$  (See Graph 2: Station wise winter and annual PM2.5 levels in cities of Mumbai). The sharp winter spike is likely attributed to a combination of increased emissions, stagnant atmospheric conditions, and reduced pollutant dispersion.

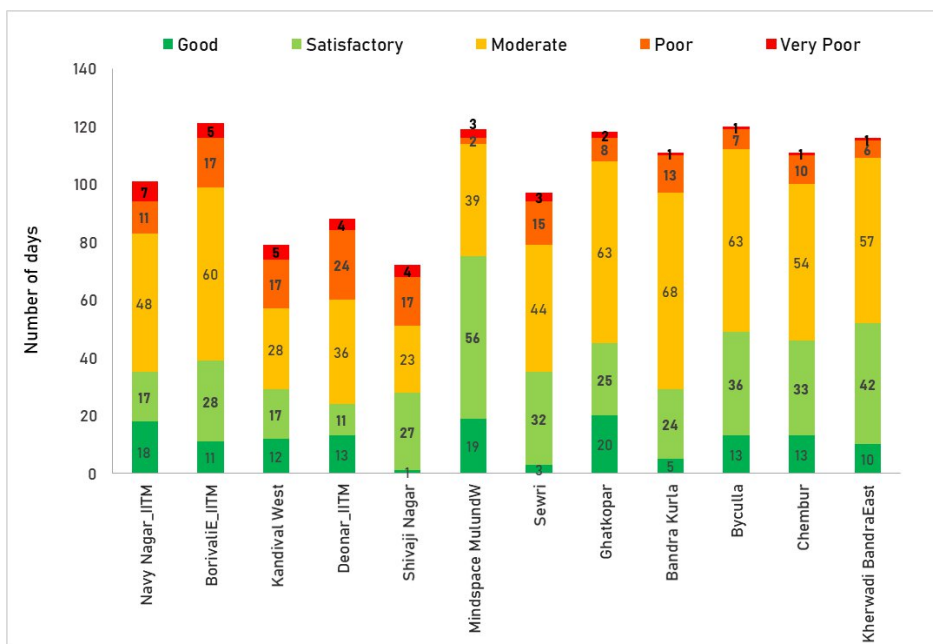
**Graph 2: Station wise winter and annual PM2.5 levels in cities of Mumbai**



Source: CSE analysis of CPCB real-time data

**Despite low winter average PM2.5 levels, cities in Mumbai experienced a significant number of days with ‘poor’ and ‘very poor’ AQI:** Deonar recorded the highest number of such days, with 28 days of poor and very poor AQI. It is followed by Kandival West and Borivali East, each with 22 days, and Shivaji Nagar with 21 days. Navy Nagar and Sewri both experienced 18 days of poor and very poor air quality. Out of 31 stations in the city, 14 stations have registered poor and very poor days ranging from 5 – 28 days. (See Graph 3: PM2.5 based AQI categorization of days for cities in Mumbai).

**Graph 3: PM2.5 based AQI categorization of days for cities in Mumbai**

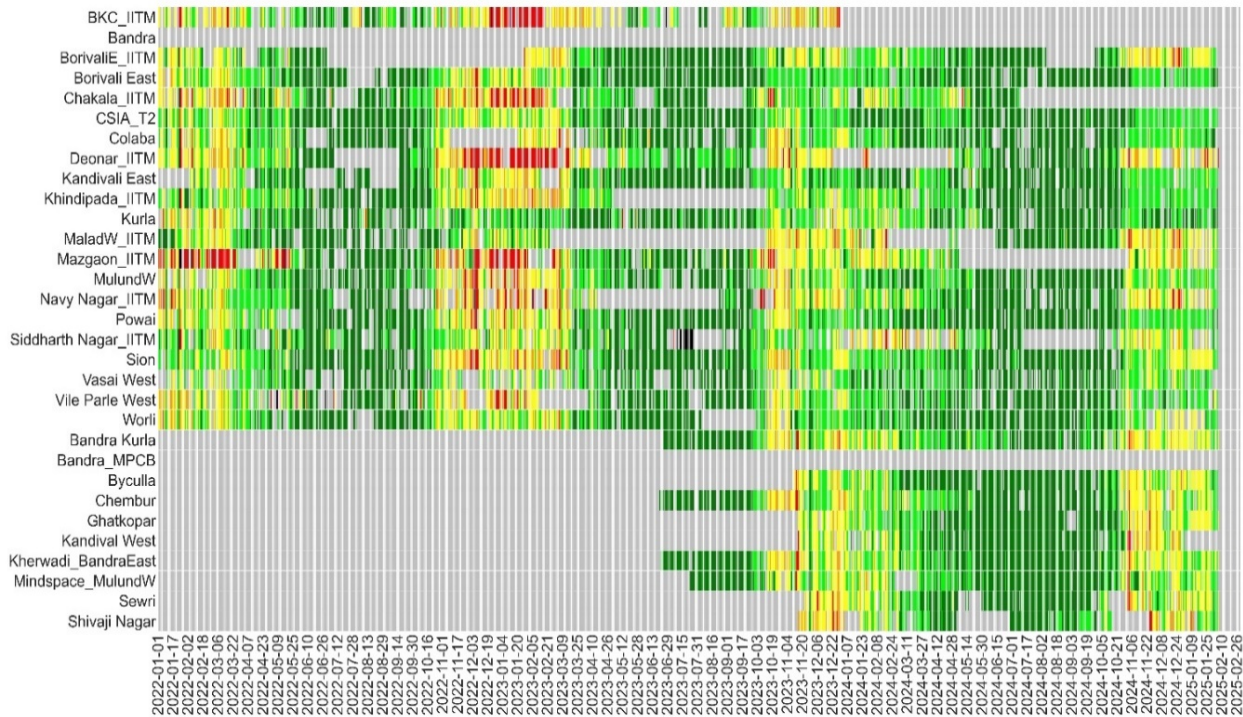


Note: PM2.5 values for cities that have continuous and adequate data for the complete assessment period. Data from 1 Oct 2024 – 31 Jan 2025.

Source: CSE analysis of real-time data from the CPCB website

Bad air days begin to build up around the same time in the cities of Mumbai during mid of November and persists till the end of January, as weather starts to cool down and winds slow down. Cities in the Mumbai Metropolitan Region show more pronounced impact of winter pollution. (See Graph 4: Heat map based on days classified as per PM2.5 air quality index for cities of Mumbai).

**Graph 4: Heat map based on days classified as per PM2.5 air quality index for cities of Mumbai**



Note: Cell colors are based on the official AQI category colors. Data up till 31 January 2025.

Source: CSE analysis of real-time data from the CPCB portal.

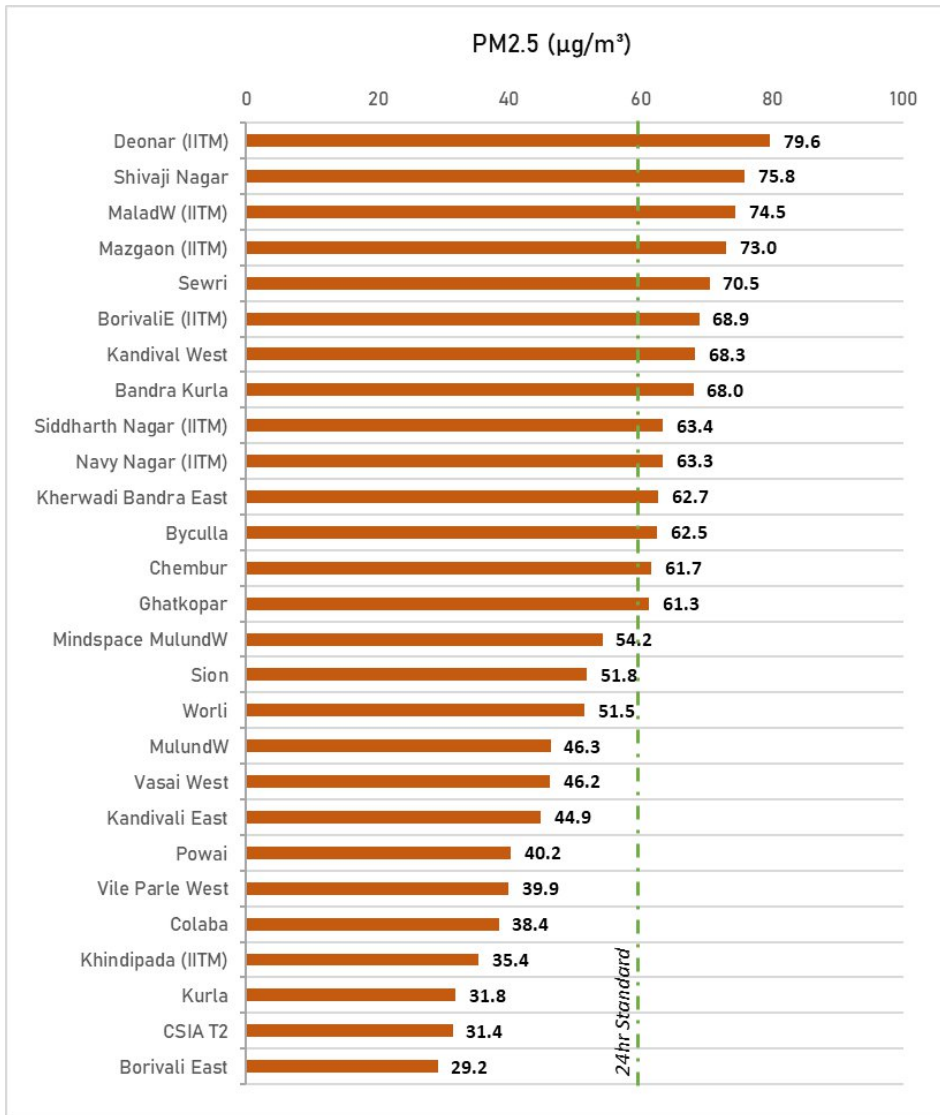
**The Pollution hotspots and cleaner cities:** Deonar is the most polluted among the cities of Mumbai with winter average PM2.5 level at 80  $\mu\text{g}/\text{m}^3$ . It is followed by Shivaji Nagar with seasonal average at 76  $\mu\text{g}/\text{m}^3$ , MaladW at 75  $\mu\text{g}/\text{m}^3$  (See Graph 5: Winter average PM2.5 level in cities of Mumbai). However, Borivali East is the least polluted city with seasonal average of 29  $\mu\text{g}/\text{m}^3$ , followed by Chhatrapati Shivaji International Airport at 31  $\mu\text{g}/\text{m}^3$  of winter average PM2.5 level.

**Borivali(E) IITM followed by Kandivali East registered the highest increase in winter pollution:** Borivali(E) IITM in Mumbai was the worst performer and registered an increase of 24 per cent compared to the preceding winter. It was followed by Kandivali East and Siddharth Nagar with an increase of 16 per cent and 14 per cent (See Graph 6: Change in Winter average PM2.5 level in cities of Mumbai (2023-24 vs 2024-25))

However, this winter many cities have shown improvement, with the most improvement was shown by Kurla with 44 per cent compared to the corresponding period during previous year. It is followed by Khindipada with 35 per cent, Colaba with 32 per cent, Vile Parle West and Borivali East each with 24 per cent and Chhatrapati Shivaji International Airport with 22 per cent (See Graph 6: Change in Winter average PM2.5 level in cities of Mumbai (2023-24 vs 2024-25)).

There is also wide variation in pollution concentration among the monitoring locations in cities of Mumbai. Deonar was the most polluted location with winter PM2.5 averaging at 79.6  $\mu\text{g}/\text{m}^3$ . Shivaji Nagar was the second most polluted location. Mumbai's monitoring station at Deonar, Shivaji Nagar, MaladW (IITM), MazgaonW (IITM), Sewri, BorivaliE (IITM), Kandival East, Bandra-Kurla, Siddharth Nagar and Navy Nagar makeup the ten most polluted city in Mumbai. (See Annex 1: PM2.5 level at station levels 1 Oct 2024-31 Jan 2025).

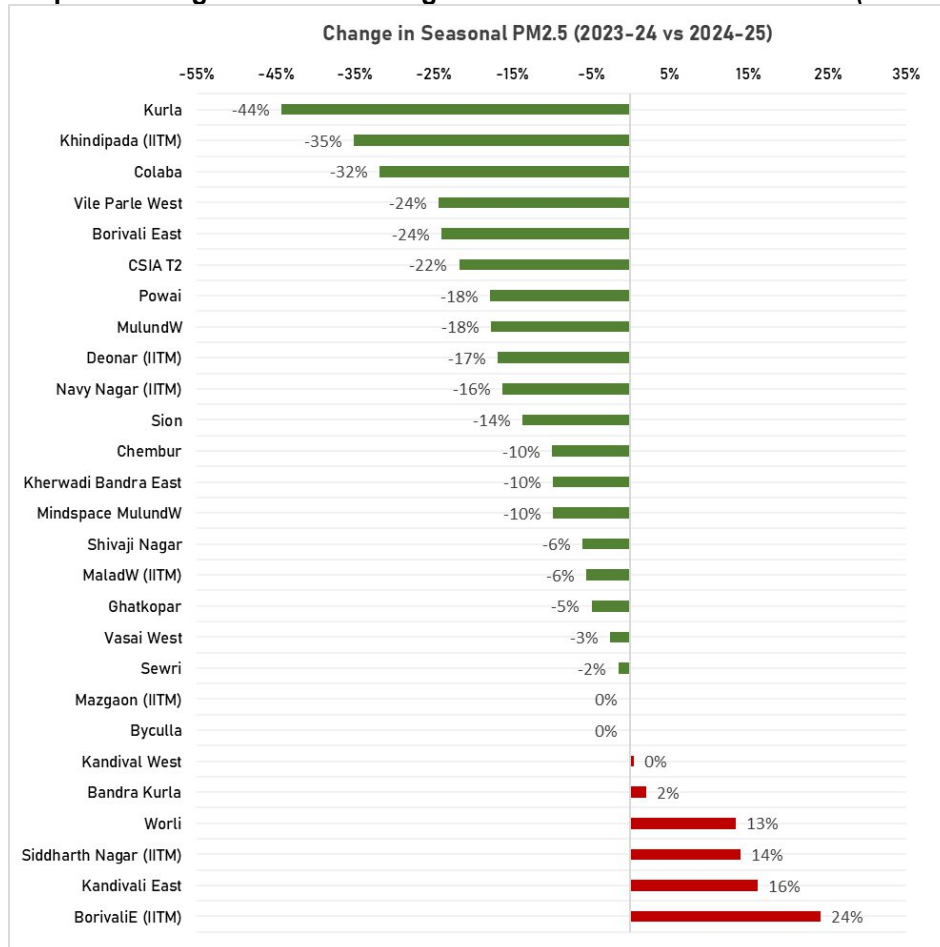
**Graph 5: Winter average PM2.5 level in cities of Mumbai (1 October 2024-31 January 2025)**



Note: 1 October 2024 – 31 January 2025 average is based on mean of daily averages.  
 Source: CSE analysis of CPCB real-time data



**Graph 6: Change in Winter average PM2.5 level in cities of Mumbai (2023-24 vs 2024-25)**



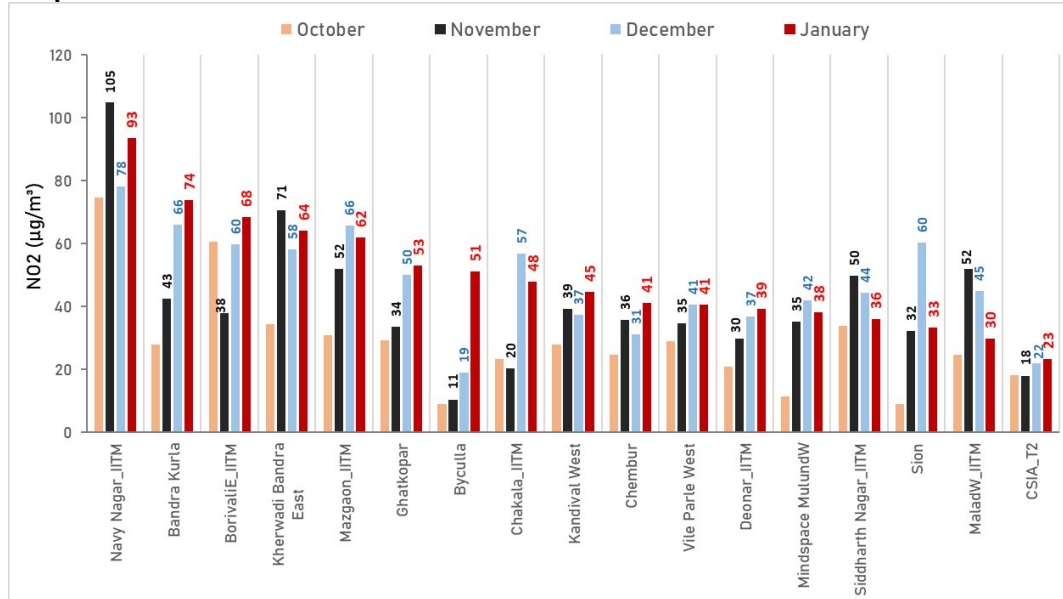
Note: 1 October-31 January 2023-24 and 2024-25 average is based on mean of daily averages. Cities with data in both 2023 and 2024 are compared.

Source: CSE analysis of CPCB real-time data

**Multi-pollutant challenge - increasing levels of Nitrogen dioxide (NO<sub>2</sub>) during November, December and January:** There is significant increase in amount of NO<sub>2</sub> concentration during November to January compared to October, 2024. NO<sub>2</sub> comes entirely from combustion sources and significantly from vehicles. Byculla in Mumbai have registered greatest increase of 5.7 times maximum build-up of NO<sub>2</sub> between October and December. Bandra-Kurla registered 2.7 times increase in NO<sub>2</sub>.

In absolute concentration, Navy Nagar registered the highest NO<sub>2</sub> average of 105 µg/m<sup>3</sup> in November and 93 µg/m<sup>3</sup> in January (See Graph 7: Trend in NO<sub>2</sub> levels in the cities of Mumbai). It is followed by Bandra Kurla with 74 µg/m<sup>3</sup> and Borivali E(IITM) with 68 µg/m<sup>3</sup>. The lowest NO<sub>2</sub> level was recorded by Chhatrapati Shivaji International Airport T2 with 23 µg/m<sup>3</sup>.

**Graph 7: Trend in NO2 levels in the cities of Mumbai**



Note: NO2 values for sub-regions are based on the average of citywide values of all the cities in that region. NO2 values is based on average of all stations that have continuous and adequate data for complete assessment period. Data up till 31 Jan 2025.  
Source: CSE analysis of real-time data from CPCB portal

**Annex 1: PM2.5 levels at station level 1 Oct 2024 – 31 Jan 2025**

| Station                    | State       | 1 Oct 2023 - 31 Jan 2024 | 1 Oct 2024 - 31 Jan 2025 |
|----------------------------|-------------|--------------------------|--------------------------|
| Mumbai_Deonar_IITM         | Maharashtra | 95.7                     | 79.6                     |
| Mumbai_ShivajiNagar        | Maharashtra | 80.7                     | 75.8                     |
| Mumbai_MaladW_IITM         | Maharashtra | 78.8                     | 74.5                     |
| Mumbai_Mazgaon_IITM        | Maharashtra | 73.1                     | 73.0                     |
| Mumbai_Sewri               | Maharashtra | 71.5                     | 70.5                     |
| Mumbai_BorivaliE_IITM      | Maharashtra | 55.5                     | 68.9                     |
| Mumbai_KandivalWest        | Maharashtra | 68.0                     | 68.3                     |
| Mumbai_BandraKurla         | Maharashtra | 66.7                     | 68.0                     |
| Mumbai_SiddharthNagar_IITM | Maharashtra | 55.6                     | 63.4                     |
| Mumbai_NavyNagar_IITM      | Maharashtra | 75.6                     | 63.3                     |
| Mumbai_Kherwadi_BandraEast | Maharashtra | 69.5                     | 62.7                     |
| Mumbai_Byculla             | Maharashtra | 62.6                     | 62.5                     |
| Mumbai_Chembur             | Maharashtra | 68.5                     | 61.7                     |
| Mumbai_Ghatkopar           | Maharashtra | 64.4                     | 61.3                     |
| Mumbai_Mindspace_MulundW   | Maharashtra | 60.1                     | 54.2                     |
| Mumbai_Sion                | Maharashtra | 60.0                     | 51.8                     |
| Mumbai_Worli               | Maharashtra | 45.4                     | 51.5                     |
| Mumbai_MulundW             | Maharashtra | 56.3                     | 46.3                     |
| Mumbai_VasaiWest           | Maharashtra | 47.5                     | 46.2                     |
| Mumbai_KandivaliEast       | Maharashtra | 38.6                     | 44.9                     |
| Mumbai_Powai               | Maharashtra | 49.0                     | 40.2                     |
| Mumbai_VileParleWest       | Maharashtra | 52.7                     | 39.9                     |
| Mumbai_Colaba              | Maharashtra | 56.4                     | 38.4                     |
| Mumbai_Khindipada_IITM     | Maharashtra | 54.5                     | 35.4                     |
| Mumbai_Kurla               | Maharashtra | 57.0                     | 31.8                     |



|                            |             |      |      |
|----------------------------|-------------|------|------|
| <b>Mumbai_CSIA_T2</b>      | Maharashtra | 40.1 | 31.4 |
| <b>Mumbai_BorivaliEast</b> | Maharashtra | 38.3 | 29.2 |

Note: Oct- Jan average is based on mean of daily averages that have continuous and adequate data for both years. All values are in  $\mu\text{g}/\text{m}^3$ .  
Source: CSE analysis of CPCB real-time data