End of winter report 2023-24: Spread and scale of air pollution crisis in India

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Centre for Science and Environment, New Delhi, March, 2024

Toxic air pollution came back to trouble the public yet again this winter. The air quality this winter started to worsen much earlier than usual due to low rains in September- October and was made even worse due to low wind speed through the season. But air quality is not a monolith, especially in India where regional variations are significant. This report of Urban Lab of Centre for Science and Environment provides a comprehensive nationwide review of winter air quality. The objective of the study has been to deepen the understanding of local and regional status, variation and trend of the winter pollution. This is part of the fourth edition of Urban Lab's Air Quality Tracker Initiative which was started in 2020 to study the impact of pandemic lockdowns on air quality of Delhi and NCR.

This concluding report on the 2023-24 winter air pollution reveals that North and East India remain the most polluted regions of India. Air quality in North India was significantly worse this winter compared to the previous winter. Meanwhile, significant improvement was noted in East India's winter air. South India continues to have the lowest regional $PM_{2.5}$. Overall, even though there is considerable variation in regional averages, high pollution episodes are common across regions. Improved realtime monitoring has strengthened the evidence that PM pollution is a regional scale problem as it is again observed that the rise and fall in PM levels is highly synchronised within regions despite large distances.

City level analysis reveals small cities in Bihar and Rajasthan as polluted big NCR cities. Begusarai in Bihar and Hanumangarh in Rajasthan are as polluted as Delhi. Industrial towns of south India and the Himalayas are also highly polluted.

Northeast and Karnataka have the cleanest cities in the country. But even cities and towns with low seasonal averages have suffered ugly spikes in daily levels. This report findings make it amply clear that this winter pollution challenge is not limited to mega cities or one specific region; it is an omnipresent problem and requires urgent and deliberate action everywhere. This requires quicker reforms and action in key sectors of pollution – vehicles, industry, power plants and waste management to control winter pollution and bend the annual air pollution curve.

Data used in the analysis: The analysis is based on publicly available granular real time data (15-minute averages) from the Central Pollution Control Board's (CPCB) official online portal Central Control Room for Air Quality Management. The data is captured from 538 official stations under the Continuous Ambient Air Quality Monitoring System (CAAQMS) spread across 254 cities in 29 states and union territories.

Regions in the analysis are defined as cluster of states and UT as given below:

- West Himalayas: Himachal Pradesh, Jammu and Kashmir, Ladakh, and Uttarakhand.
- North India: Chandigarh, Delhi, Haryana, Punjab, Rajasthan, and Uttar Pradesh.
- East India: Bihar, Jharkhand, Odisha, and West Bengal.
- Central India: Chhattisgarh and Madhya Pradesh.
- West India: Gujarat and Maharashtra.
- South India: Andhra Pradesh, Karnataka, Kerala, Puducherry, Tamil Nadu and Telangana.
- Northeast India: Arunachal Pradesh, Assam, Nagaland, Manipur, Meghalaya, Mizoram, Sikkim, Tripura.

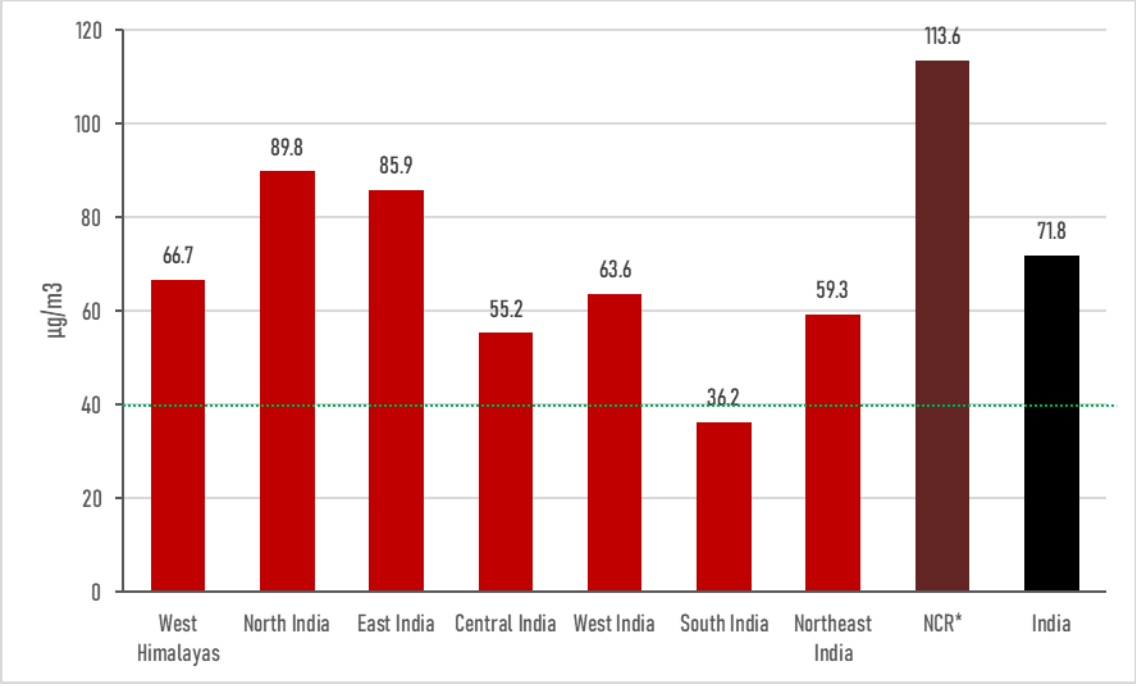
PM2.5 levels are calculated for each station using USEPA methodology for daily and seasonal averages. Data requirement has been set at minimum 50 per cent data completeness i.e. minimum 60 valid 24-hr values between 1 Oct 2023 and 31 Jan 2024. Only the stations that meet this minimum data completeness criteria are considered in this study. Cities with multiple stations have their PM level defined as the mean of all the city stations that meet the minimum data completeness criteria.

Key findings

All India summary

North India and East India were the most polluted regions in the country, while South India was the cleanest: The average of winter $PM_{2.5}$ level of cities among the seven major regions of the country shows that the North and East are the most polluted. Average of North India cities stands at 89.9 µg/m^3 while East India cities average at 85.9 µg/m^3 (see *Graph 1: Regional winter average $PM_{2.5}$ levels 2023-24*). NCR, a sub-region within the North, had a much higher average of 113.6 µg/m^3. South Indian cities averaged just 36.2 µg/m^3 which makes it the least polluted region. Central Indian cities with an average of 55.2 µg/m^3 were the second least polluted region. West Indian cities averaged at 63.6 µg/m^3. Himalayan cities averaged at 66.7 µg/m^3 but it must be noted that only four cities have realtime monitoring with adequate data and all these cities are in the foothill zones. Northeast India cities average 59.3 µg/m^3. Overall the average of all cities in the country stands at 71.8 µg/m^3 which is 80 per cent above the annual standard.

Graph 1: Regional winter average $PM_{2.5}$ levels 2023-24

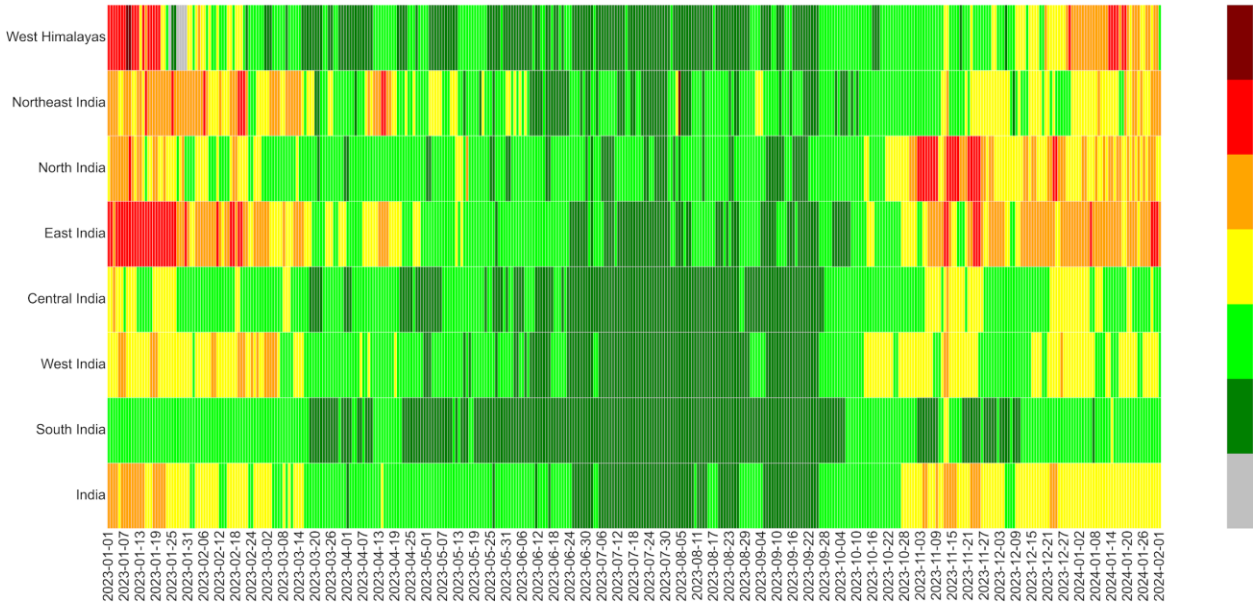


Note: Regional average PM2.5 level is based on the mean of winter value determined for each city in the region. Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3.
Source: CSE analysis of CPCB's real time air quality data

Worst daily air quality is reported on and around Diwali in all regions expect the hills that have worst air in January; NCR is also an outlier as it worst air quality was recorded 10 days before Diwali: The nationwide peak $PM_{2.5}$ (daily average) stood at 120 µg/m^3 and it was observed on 13 November 2023 (day after Diwali). Second worst day nationwide was 12 November 2023 (Diwali day). This was reflected at regional level as the worst two days of the winter in North, East, Central, West and South were either Diwali or the day after Diwali as well. NCR within the larger North region deviated from the pattern as it recorded its peak on 3 November 2023 which can be attributed to smoke from farm stubble fires and restrictions on firecrackers at Diwali (see *Graph 2: Heatmap of daily regional PM2.5 levels 2023-24*). Meanwhile, regional peaks in the Himalayan States happened on 13 January 2024 and in Northeast India on 22 January 2024.

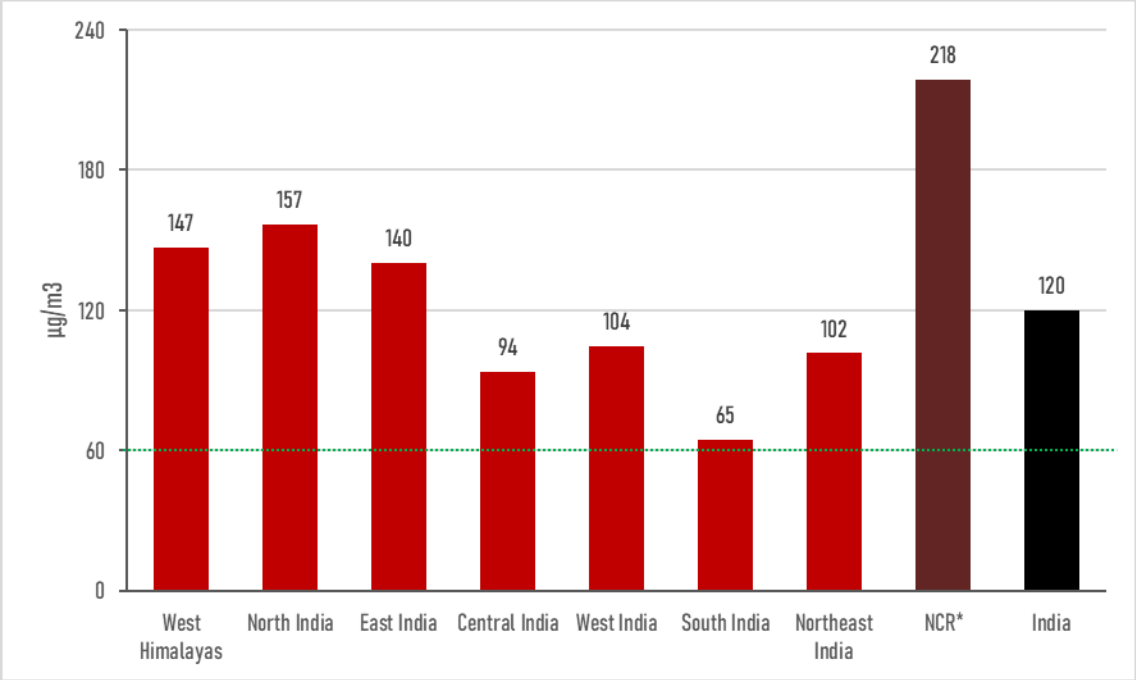
Magnitude of the regional peak was highest in North India where 24hr average stood at 156.7 µg/m^3 (see *Graph 3: Regional winter peak PM2.5 levels 2023-24*). NCR within North India stood at 202 µg/m^3 on the Diwali day but its own peak was 218.4 µg/m^3 recorded on 3 November 2023. Region peak for the West Himalayas was the second worst with a 24hr average of 146.7 µg/m^3. It was closely followed by the East India regional peak of 140 µg/m^3. West India peak was 104.5 µg/m^3. Northeast India peak was 101.5 µg/m^3. Central India peak was 93.7 µg/m^3. South India peak was 64.6 µg/m^3.

Graph 2: Heatmap of daily regional PM2.5 levels 2023-24



Note: Regional average PM2.5 level is based on the mean of winter value determined for each city in the region. Winter value of a city is based on mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter
Source: CSE analysis of CPCB's real time air quality data

Graph 3: Regional winter peak PM2.5 levels 2023-24

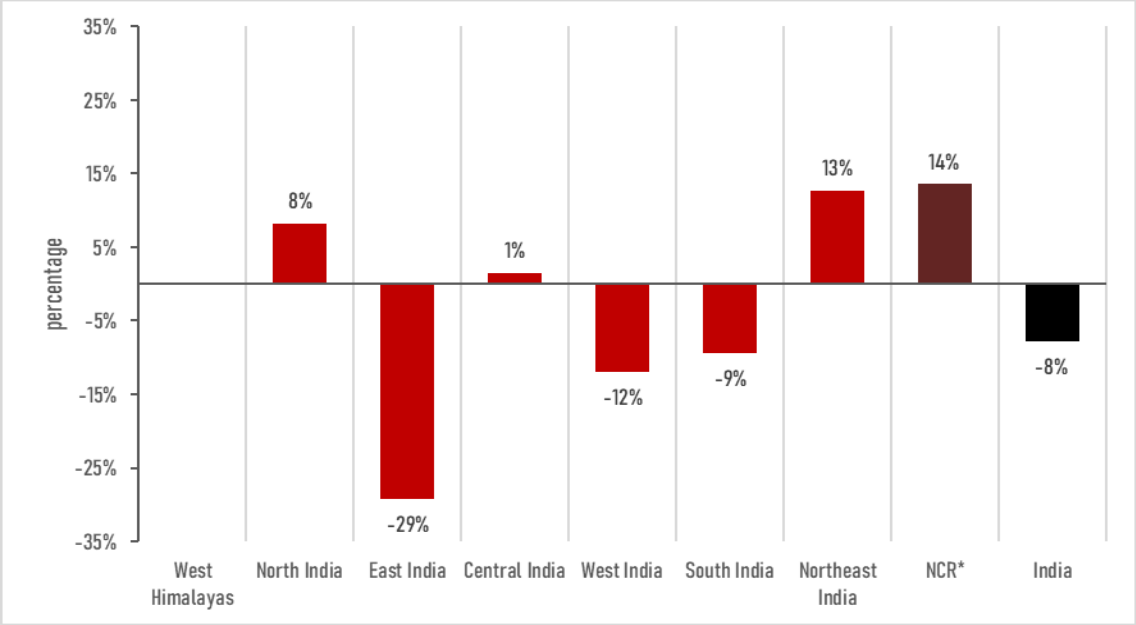


Note: Regional peak PM2.5 level is based on the mean of daily value determined for each city in the region for each day. Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 18 hours data in a day. The winter is defined as 1 Oct 2023 to 31 Jan 2024.
Source: CSE analysis of CPCB's real time air quality data

Winter average is up for North and Northeast but pollution down by 29 per cent in East India: Compared to the winter of 2022-23 the average PM2.5 level this winter is up by 13 per cent among the Northeast cities and 8 per cent among the North cities (see *Graph 4: Change in regional winter average PM2.5 levels 2022-23 vs 2023-24*). NCR cities within the North registered 14 per cent higher $PM_{2.5}$ level. Average of East cities shows a decline of 29 per cent compared to previous winter. Cities of West and South show pollution decline of about 10 per cent. Central Indian cities show insignificant change. Overall at all India levels the winter was on average 8 per cent less polluted compared to previous winter. Not enough data was available from Himalayan states to carry out a similar comparison.

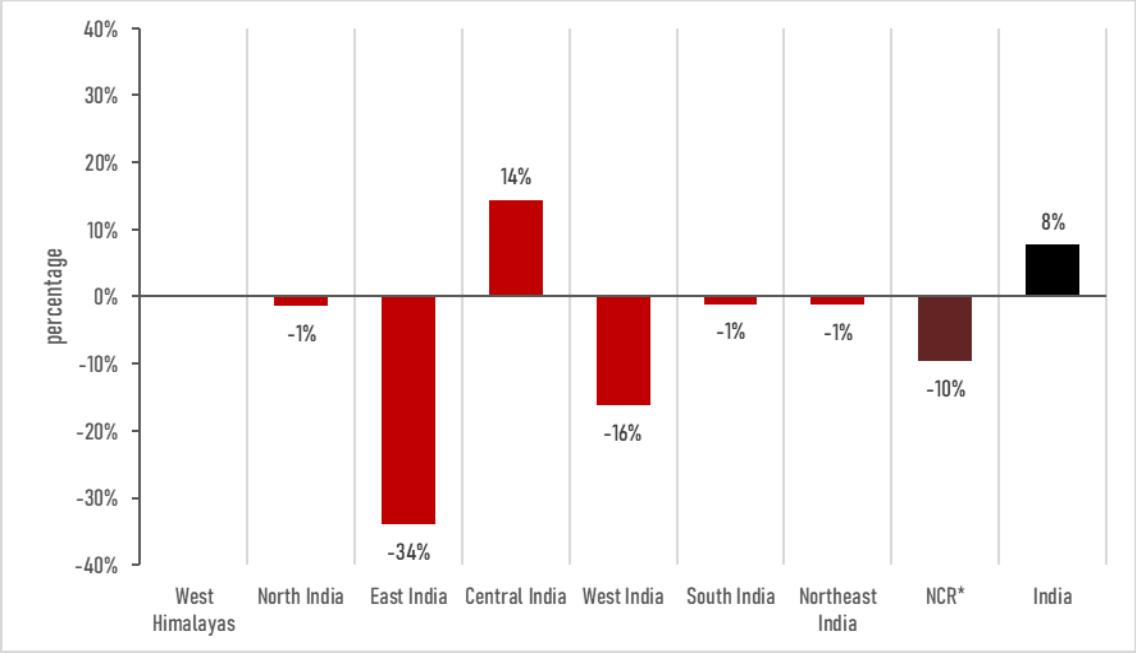
Regional peak pollution is down in all regions except Central India: Worst day this winter was 14 per cent more polluted in Central India compared to the previous winter's worst day. The regional peak in the East is lower by 34 per cent and in the West by 16 per cent. North, South and Northeast show no significant change in the peak 24-hr $PM_{2.5}$ level. NCR, which is a part of the North, experienced a peak which was 10 per cent lower compared to the previous winter peak (see *Graph 5: Change in regional winter peak PM2.5 levels 2022-23 vs 2023-24*). Interestingly, at all India levels the worst day had 8 per cent higher $PM_{2.5}$ level.

Graph 4: Change in regional winter average $PM_{2.5}$ levels 2022-23 vs 2023-24



Note: Regional average PM2.5 level is based on the mean of winter value determined for each city in the region. Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for both 2022-23 and 2023-24 winters. The winter is defined as 1 Oct to 31 Jan. Source: CSE analysis of CPCB's real time air quality data

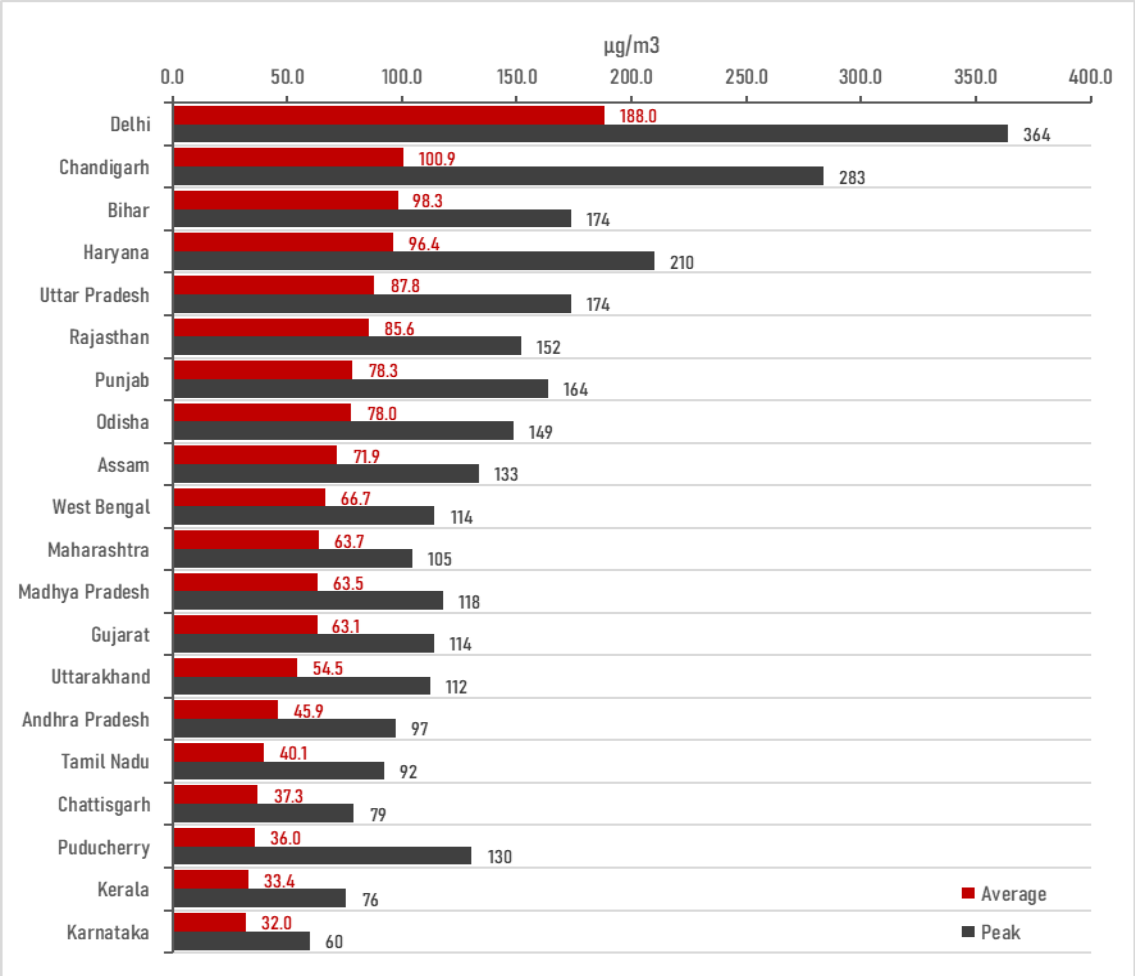
Graph 5: Change in regional winter peak $PM_{2.5}$ levels 2022-23 vs 2023-24



Note: Regional average PM2.5 level is based on the mean of winter value determined for each city in the region. Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for both 2022-23 and 2023-24 winters. The winter is defined as 1 Oct to 31 Jan. Source: CSE analysis of CPCB's real time air quality data

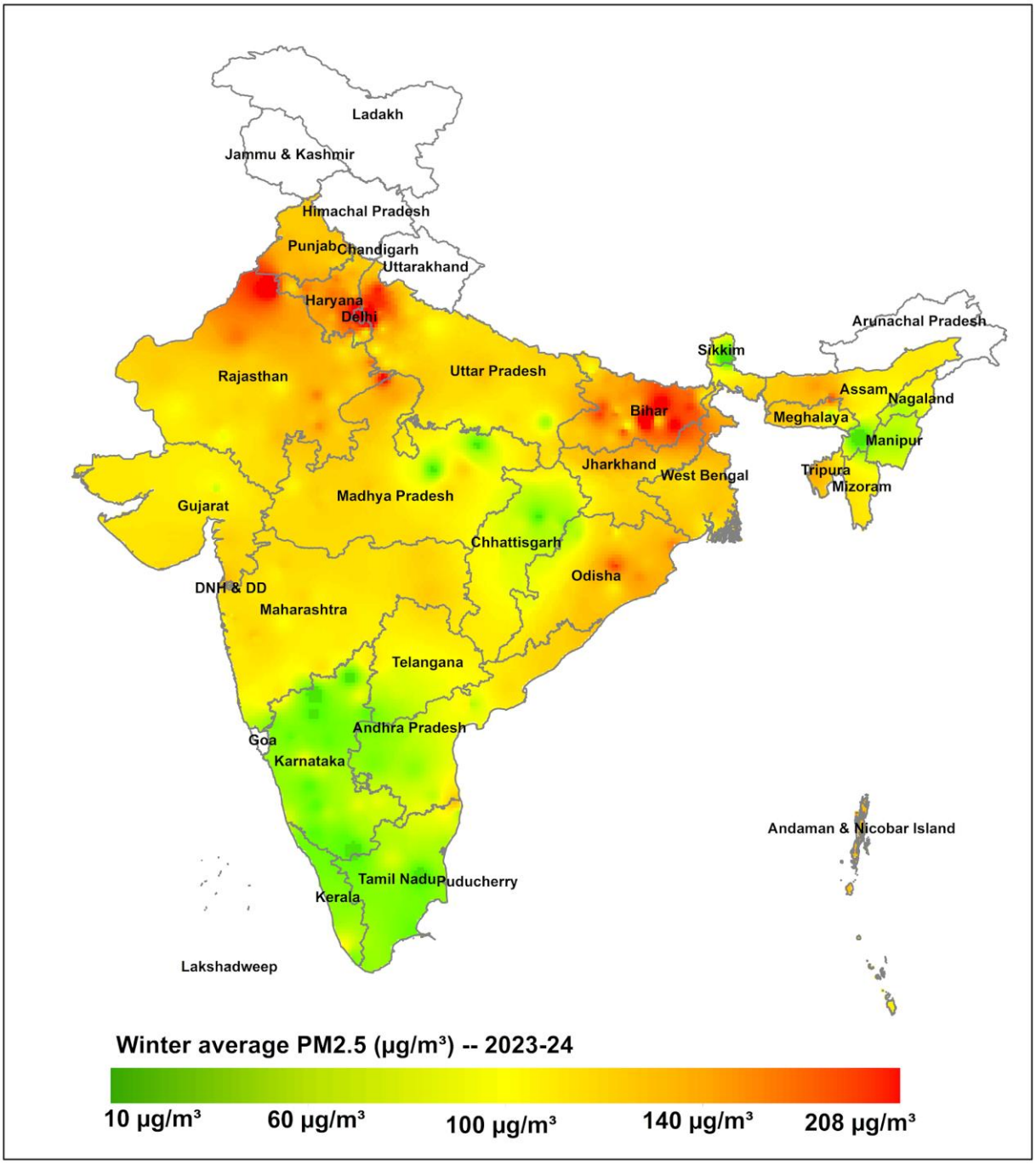
Delhi and Chandigarh were the most polluted UTs while Bihar and Haryana the most polluted states: There are 20 states and UT that have monitoring in multiple cities which have allowed to establish approximate state-UT average $PM_{2.5}$ level. The average winter $PM_{2.5}$ level for Delhi and Chandigarh stood at 188 µg/m^3 and 100.9 µg/m^3 respectively making them the most polluted UT or state in the country. Bihar and Haryana with winter average of 98.3 µg/m^3 and 96.4 µg/m^3 respectively were the most polluted states. Uttar Pradesh, Rajasthan and Punjab closely followed (see *Graph 6: State-wise winter average and peak PM2.5 levels 2023-24* & *Map 1: Spatial variation in winter PM2.5 levels across India 2023-24*). Karnataka was the cleanest state with a winter average of 32 µg/m^3. Kerala was the second least polluted state with a winter average of 33.4 µg/m^3. There are eight states (Himachal Pradesh, Tripura, Meghalaya, Jharkhand, Manipur, Telangana, Nagaland and Sikkim) that have monitoring only in one city therefore no statewide assessment could be undertaken. Trend in peak pollution was nearly identical to the trend in winter average.

Graph 6: State-wise winter average and peak $PM_{2.5}$ levels 2023-24



Note: Regional average PM2.5 level is based on the mean of winter value determined for each city in the region. Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3.
Source: CSE analysis of CPCB's real time air quality data

Map 1: Spatial variation in winter $PM_{2.5}$ levels across India 2023-24



Source: CSE analysis of CPCB's real time air quality data

Small cities in Bihar and Rajasthan are as polluted as big NCR cities: The average winter $PM_{2.5}$ level for Begusarai in Bihar stood at 213.5 µg/m^3 making it the most polluted city in the country. Delhi and Hanumangarh in Rajasthan were the next most polluted cities with a winter average of 188.0 µg/m^3 and 171.6 µg/m^3. Among the 20 most polluted cities this winter 11 are located in NCR (see *Table 1: Top 20 cities with worst winter air quality 2023-24*). These are Delhi, Greater Noida, Faridabad, Nodia, Ghaziabad, Bhiwadi, Sonipat, Muzaffarnagar, Gurugram, Bahadurgarh and Meerut. Four cities from Bihar (namely Begusarai, Saharsa, Bhagalpur and Purnia), four cities from Rajasthan (namely Hanumangarh, Dholpur, Bhiwadi and Sri Ganganagar), Byrnihat in Assam and Angul in Odisha are non-NCR cities in the 20 most polluted cities of this winter.

Table 1: Top 20 cities with worst winter air quality 2023-24

	City	State	Winter average
1	Begusarai	BR	213.5
2	Delhi	DL (NCR)	188.0
3	Hanumangarh	RJ	171.6
4	Greater Noida	UP (NCR)	166.2
5	Faridabad	HR (NCR)	153.5
6	Noida	UP (NCR)	152.3
7	Dholpur	RJ	146.3
8	Saharsa	BR	146.0
9	Ghaziabad	UP (NCR)	143.1
10	Bhagalpur	BR	140.6
11	Bhiwadi	RJ (NCR)	136.6
12	Sonipat	HR (NCR)	134.7
13	Muzaffarnagar	UP (NCR)	132.8
14	Byrnihat	AS	130.6
15	Gurugram	HR (NCR)	130.3
16	Bahadurgarh	HR (NCR)	130.0
17	Purnia	BR	129.7
18	Sri Ganganagar	RJ	129.6
19	Angul	OR	128.5
20	Meerut	UP (NCR)	128.3

Note: Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3.
Source: CSE analysis of CPCB's real time air quality data

Small towns in Karnataka and Northeast are the cleanest in the country: The average winter PM2.5 level for Gangtok in Sikkim stood at 9.8 µg/m^3 making it the least polluted city in the country. Silchar in Assam was the second least polluted city with a winter average of 14.9 µg/m^3. Chamarajanagar, Vijaypura and Kalaburagi in Karnataka were the other cities among the top five cleanest cities this winter(see *Table 2: Top 20 cities with best winter air quality 2023-24*). Mysuru was the cleanest major city. Ariyalur, Ramanathapuram and Ooty in Tamil Nadu also featured among the 20 least polluted cities this winter. Three cities from central India (namely Satna, Damoh and Korba) also registered very low winter average but accuracy of their data is doubtful as it doesn't show seasonal variation in $PM_{2.5}$ levels as seen in the region, field investigation needed to verify their data was beyond the scope of this study.

Table 2: Top 20 cities with best winter air quality 2023-24

	City	State	Winter average
1	Gangtok	SK	9.8
2	Silchar	AS	14.9
3	Chamarajanagar	KA	18.1
4	Vijaypura	KA	18.6
5	Kalaburagi	KA	19.4
6	Ariyalur	TN	21.3
7	Satna	MP	21.5
8	Damoh	MP	22.4
9	Korba	CG	22.5
10	Bagalkot	KA	22.7
11	Shivamogga	KA	24.8
12	Chikkamagaluru	KA	25.1
13	Madikeri	KA	25.1
14	Dharwad	KA	25.5
15	Mysuru	KA	25.7
16	Raichur	KA	26.0
17	Koppal	KA	26.5
18	Ramanathapuram	TN	27.0
19	Ooty	TN	27.7
20	Kannur	KL	27.8

Note: Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3.
Source: CSE analysis of CPCB's real time air quality data

West Himalayas

Baddi in HP is the most polluted city in the West Himalayas: Only five cities in the western Himalayas have realtime monitoring and of them Srinagar, JK doesn't have enough data to carry out any air quality analysis. Of the four cities with adequate data Baddi, HP with winter average of 111.8 µg/m^3 and winter peak of 343 µg/m^3 was by far the most polluted (see *Table 3: Winter air quality among cities of West Himalayas 2023-24*). Winter pollution is up by 6 per cent in Baddi compared to previous winter. Dehradun is the second most polluted with winter average of 70.2 µg/m^3 and winter peak of 155 µg/m^3. Rishikesh is the cleanest city in the region with a winter average of 35.8 µg/m^3 and a winter peak of 84 µg/m^3.

Table 3: Winter air quality among cities of West Himalayas 2023-24

	City	State	Winter average	Winter peak
1	Baddi	HP	111.8	343
2	Dehradun	UK	70.2	155
3	Kashipur	UK	58.8	118
4	Rishikesh	UK	35.8	84

Note: Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3.
Source: CSE analysis of CPCB's real time air quality data

North India

Delhi and Hanumangarh RJ are the most polluted cities in the North: 88 cities in the North have realtime monitoring and enough data for the winter to carry out air quality analysis. Delhi with a winter average of 188 µg/m^3 and winter peak of 364 µg/m^3 was the most polluted city in the region. 17 out of the 20 most polluted cities in the region are located within the NCR. Three cities of Rajasthan (Hanumangarh, Dholpur and Sri Ganganagar) make up the rest of the 20 most polluted in the region. Hanumangarh, RJ was the second most polluted in the region with a winter average of 171.6 µg/m^3 and winter peak of 339 µg/m^3 (see *Table 4: Winter air quality among cities of North India 2023-24*). Among other major cities Chandigarh registered winter average of 100.9 µg/m^3 and winter peak of 283 µg/m^3, Jaipur registered winter average of 89.6 µg/m^3 and winter peak of 179 µg/m^3, and Lucknow registered winter average of 82.8 µg/m^3 and winter peak of 145 µg/m^3. Varanasi and Haryana cities of Mandikhera and Palwal were the cleanest in the region.

Table 4: Winter air quality among cities of North India 2023-24

	City	State	Winter average	Winter peak
1	Delhi	DL (NCR)	188.0	364
2	Hanumangarh	RJ	171.6	339
3	Greater Noida	UP (NCR)	166.2	499
4	Faridabad	HR (NCR)	153.5	322
5	Noida	UP (NCR)	152.3	364
6	Dholpur	RJ	146.3	280
7	Ghaziabad	UP (NCR)	143.1	314
8	Bhiwadi	RJ (NCR)	136.6	278
9	Sonipat	HR (NCR)	134.7	324
10	Muzaffarnagar	UP (NCR)	132.8	234
11	Gurugram	HR (NCR)	130.3	352
12	Bahadurgarh	HR (NCR)	130.0	294
13	Sri Ganganagar	RJ	129.6	357
14	Meerut	UP (NCR)	128.3	310
15	Ballabgarh	HR (NCR)	126.6	268
16	Rohtak	HR (NCR)	119.1	301
17	Baghpat	UP (NCR)	116.7	343
18	Bharatpur	RJ (NCR)	115.2	315
19	Manesar	HR (NCR)	112.9	275
20	Jind	HR (NCR)	112.1	351
21	Bikaner	RJ	112.1	299
22	Fatehabad	HR	112.0	444
23	Hapur	UP (NCR)	111.3	211
24	Kaithal	HR	109.5	339
25	Tonk	RJ	108.8	206
26	Kota	RJ	106.9	275
27	Bhiwani	HR (NCR)	103.5	256
28	Dharuhera	HR (NCR)	102.4	233
29	Jhunjhunu	RJ	101.0	358
30	Chandigarh	CH	100.9	283

	City	State	Winter average	Winter peak
31	Churu	RJ	100.8	352
32	Bulandshahr	UP (NCR)	97.9	204
33	Hisar	HR	96.8	338
34	Kurukshetra	HR	96.4	190
35	Sikar	RJ	92.3	277
36	Charkhi Dadri	HR (NCR)	91.0	173
37	Mandi Gobindgarh	PB	90.8	226
38	Dausa	RJ	90.1	211
39	Jaipur	RJ	89.6	179
40	Bhatinda	PB	88.1	263
41	Chittorgarh	RJ	85.7	163
42	Ludhiana	PB	85.1	221
43	Karnal	HR (NCR)	82.9	190
44	Lucknow	UP	82.8	145
45	Narnaul	HR (NCR)	81.3	332
46	Panipat	HR (NCR)	80.2	181
47	Bundi	RJ	80.0	191
48	Bhilwara	RJ	79.6	170
49	Jaisalmer	RJ	78.6	217
50	Jalandhar	PB	77.8	202
51	Rupnagar	PB	77.4	166
52	Jhalawar	RJ	77.1	177
53	Amritsar	PB	76.8	164
54	Yamuna Nagar	HR	76.4	186
55	Nagaur	RJ	76.0	213
56	Pali	RJ	74.0	145
57	Baran	RJ	70.7	172
58	Karauli	RJ	70.7	230
59	Jalore	RJ	70.6	194
60	Patiala	PB	70.2	154
61	Banswara	RJ	70.1	169
62	Kanpur	UP	68.4	131
63	Sirsa	HR	68.3	320
64	Sawai Madhopur	RJ	68.0	145
65	Gorakhpur	UP	67.3	289
66	Prayagraj	UP	65.9	129
67	Khanna	PB	65.8	138
68	Jodhpur	RJ	65.2	150
69	Moradabad	UP	65.1	172
70	Dungarpur	RJ	64.8	142
71	Panchkula	HR	64.3	153
72	Udaipur	RJ	64.1	126
73	Ambala	HR	63.3	146
74	Rajsamand	RJ	62.8	149
75	Alwar	RJ (NCR)	62.7	115
76	Khurja	UP (NCR)	62.2	169

	City	State	Winter average	Winter peak
77	Firozabad	UP	62.0	107
78	Pratapgarh	RJ	60.1	151
79	Agra	UP	57.6	101
80	Jhansi	UP	56.0	100
81	Ajmer	RJ	53.6	131
82	Barmer	RJ	51.2	176
83	Vrindavan	UP	48.9	113
84	Bareilly	UP	47.6	108
85	Sirohi	RJ	46.1	99
86	Palwal	HR	38.5	182
87	Mandikhera	HR (NCR)	34.8	121
88	Varanasi	UP	34.0	118

Note: Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3. Source: CSE analysis of CPCB's real time air quality data

Panipat and Sonipat in Haryana registered steepest increase in pollution in the North: 62 cities in the North have realtime monitoring and enough data for both winters to carry out trend analysis. 39 of these 62 cities registered an increase in their winter $PM_{2.5}$ level compared to the previous winter. Panipat registered an 87 per cent increase and Sonipat registered an 80 per cent increase that is by far the steepest increase in the region. Hapur, Bhiwadi, Kota, Bhatinda and Mandikhera also registered a steep increase in the range of 40-50 per cent (see *Table 5: Trend in winter air quality among cities of North India 2022-23 vs 2023-24*). Among major cities Jaipur registered 38 per cent increase, Delhi registered 17 per cent increase, Chandigarh registered 9 per cent increase, and Lucknow registered 4 per cent decrease. Varanasi, Khurja and Dharuhera registered improvement in access of 25 per cent.

Table 5: Trend in winter air quality among cities of North India 2022-23 vs 2023-24

	City	State	Change in winter average	Change in winter peak
1	Panipat	HR (NCR)	87%	34%
2	Sonipat	HR (NCR)	80%	40%
3	Hapur	UP (NCR)	45%	24%
4	Bhiwadi	RJ (NCR)	42%	3%
5	Kota	RJ	42%	34%
6	Bhatinda	PB	41%	71%
7	Mandikhera	HR (NCR)	40%	5%
8	Jaipur	RJ	38%	-16%
9	Ballabgarh	HR (NCR)	37%	12%
10	Rohtak	HR (NCR)	32%	-9%
11	Pali	RJ	28%	12%
12	Fatehabad	HR	28%	72%
13	Bahadurgarh	HR (NCR)	23%	-14%
14	Noida	UP (NCR)	22%	3%
15	Rupnagar	PB	21%	12%
16	Delhi	DL (NCR)	17%	-9%
17	Vrindavan	UP	16%	33%
18	Alwar	RJ (NCR)	15%	1%
19	Bhiwani	HR (NCR)	15%	-18%

	City	State	Change in winter average	Change in winter peak
20	Greater Noida	UP (NCR)	13%	61%
21	Firozabad	UP	13%	-13%
22	Kaithal	HR	13%	23%
23	Faridabad	HR (NCR)	12%	13%
24	Palwal	HR	11%	133%
25	Gorakhpur	UP	10%	137%
26	Agra	UP	9%	-6%
27	Chandigarh	CH	9%	20%
28	Patiala	PB	9%	-25%
29	Jalandhar	PB	8%	38%
30	Muzaffarnagar	UP (NCR)	6%	-22%
31	Kurukshetra	HR	5%	-56%
32	Ghaziabad	UP (NCR)	5%	-9%
33	Narnaul	HR (NCR)	5%	103%
34	Meerut	UP (NCR)	4%	13%
35	Prayagraj	UP	4%	7%
36	Karnal	HR	4%	-5%
37	Moradabad	UP	3%	-9%
38	Khanna	PB	2%	-53%
39	Mandi Gobindgarh	PB	1%	9%
40	Hisar	HR	-1%	22%
41	Manesar	HR (NCR)	-2%	-9%
42	Jind	HR (NCR)	-2%	5%
43	Amritsar	PB	-3%	10%
44	Gurugram	HR (NCR)	-3%	-6%
45	Panchkula	HR	-3%	2%
46	Lucknow	UP	-4%	-3%
47	Bulandshahr	UP (NCR)	-5%	-4%
48	Ajmer	RJ	-6%	10%
49	Yamuna Nagar	HR	-7%	-24%
50	Ludhiana	PB	-7%	-10%
51	Sirsa	HR	-8%	36%
52	Charkhi Dadri	HR (NCR)	-8%	-51%
53	Udaipur	RJ	-8%	-2%
54	Jhansi	UP	-10%	-25%
55	Jodhpur	RJ	-11%	-49%
56	Baghpat	UP (NCR)	-14%	-7%
57	Kanpur	UP	-17%	-28%
58	Ambala	HR	-20%	-63%
59	Bareilly	UP	-24%	-19%
60	Dharuhera	HR (NCR)	-26%	-9%
61	Khurja	UP (NCR)	-28%	-4%
62	Varanasi	UP	-32%	30%

Note: Winter value of a city is based on mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for both 2022-23 and 2023-24 winters. The winter is defined as 1 Oct to 31 Jan. Source: CSE analysis of CPCB's real time air quality data

East India

Begusarai and Saharsa in Bihar are the most polluted cities in the East: 45 cities in the East have realtime monitoring and enough data for the winter to carry out air quality analysis. Begusarai with a winter average of 213.5 µg/m^3 and winter peak of 477 µg/m^3 was the most polluted city in the region. Saharsa was the second most polluted in the region with a winter average of 146 µg/m^3 and winter peak of 321 µg/m^3. Nine out of the 10 most polluted cities in the region are located in Bihar. Angul in Odisha is the most polluted city in the region outside Bihar with winter average of 128.5 µg/m^3 and winter peak of 221 µg/m^3. Howrah was the most polluted city in West Bengal (see *Table 6: Winter air quality among cities of East India 2023-24*). Among other major cities Patna registered winter average of 117.1 µg/m^3 and winter peak of 210 µg/m^3, Bhubaneswar registered winter average of 100 µg/m^3 and winter peak of 242 µg/m^3, and Kolkata registered winter average of 77.1 µg/m^3 and winter peak of 135 µg/m^3. Brajrajnagar was the cleanest in the region with winter average under 40 µg/m^3.

Table 6: Winter air quality among cities of East India 2023-24

	City	State	Winter average	Winter peak
1	Begusarai	BR	213.5	477
2	Saharsa	BR	146.0	321
3	Bhagalpur	BR	140.6	285
4	Purnia	BR	129.7	294
5	Angul	OR	128.5	221
6	Arrah	BR	126.6	233
7	Rajgir	BR	125.6	232
8	Chhapra	BR	122.8	233
9	Katihar	BR	121.6	268
10	Araria	BR	118.2	338
11	Patna	BR	117.1	210
12	Balasore	OR	108.0	249
13	Talcher	OR	107.2	236
14	Cuttack	OR	105.8	215
15	Muzaffarpur	BR	102.1	182
16	Bhubaneswar	OR	100.0	242
17	Motihari	BR	98.4	197
18	Siwan	BR	94.2	265
19	Samastipur	BR	92.1	208
20	Howrah	WB	86.3	149
21	Baripada	OR	82.8	243
22	Byasanagar	OR	82.0	185
23	Keonjhar	OR	81.1	172
24	Bettiah	BR	80.6	200
25	Barbil	OR	78.7	135
26	Bileipada	OR	78.6	135
27	Gaya	BR	78.5	162
28	Kolkata	WB	77.1	135
29	Rairangpur	OR	76.9	162
30	Sasaram	BR	75.3	163
31	Asansol	WB	75.2	185

	City	State	Winter average	Winter peak
32	Munger	BR	73.4	120
33	Suakati	OR	69.9	128
34	Hajipur	BR	69.0	128
35	Rourkela	OR	68.7	139
36	Dhanbad	JH	61.3	120
37	Durgapur	WB	60.8	170
38	Nayagarh	OR	59.2	114
39	Kishanganj	BR	58.4	136
40	Haldia	WB	51.0	81
41	Siliguri	WB	47.2	96
42	Tensa	OR	47.1	88
43	Bihar Sharif	BR	42.2	165
44	Manguraha	BR	40.3	124
45	Brajrajnagar	OR	37.7	73

Note: Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3.
Source: CSE analysis of CPCB's real time air quality data

Talcher and Haldia registered the steepest increase in pollution in the East: 37 cities in the North have realtime monitoring and enough data for both winters to carry out trend analysis. 3 of these 37 cities registered an increase in their winter $PM_{2.5}$ level compared to the previous winter. Talcher registered a 43 per cent increase and Haldia registered a 10 per cent increase that is by far the steepest increase in the region (see *Table 7: Trend in winter air quality among cities of East India 2022-23 vs 2023-24*). Arrah in Bihar was the only other city that registered an increase. Among major cities Kolkata registered a 9 per cent decrease and Patan registered a 23 per cent decrease. Bihar Sharif, Bettiah and Siwan registered improvement in access of 50 per cent.

Table 7: Trend in winter air quality among cities of East India 2022-23 vs 2023-24

	City	State	Change in winter average	Change in winter peak
1	Talcher	OR	43%	88%
2	Haldia	WB	10%	-18%
3	Arrah	BR	5%	-20%
4	Durgapur	WB	-7%	37%
5	Bhagalpur	BR	-9%	-16%
6	Kolkata	WB	-9%	-11%
7	Rajgir	BR	-10%	-39%
8	Howrah	WB	-11%	-21%
9	Keonjhar	OR	-12%	17%
10	Baripada	OR	-14%	65%
11	Araria	BR	-14%	33%
12	Rairangpur	OR	-14%	10%
13	Motihari	BR	-15%	-40%
14	Bileipada	OR	-20%	-31%
15	Siliguri	WB	-21%	-31%
16	Suakati	OR	-22%	-24%
17	Saharsa	BR	-23%	-31%
18	Patna	BR	-23%	-29%
19	Nayagarh	OR	-24%	-11%

	City	State	Change in winter average	Change in winter peak
20	Rourkela	OR	-24%	-14%
21	Begusarai	BR	-26%	-20%
22	Chhapra	BR	-28%	-49%
23	Asansol	WB	-29%	-6%
24	Muzaffarpur	BR	-30%	-45%
25	Tensa	OR	-31%	-41%
26	Gaya	BR	-33%	-34%
27	Purnia	BR	-33%	-20%
28	Hajipur	BR	-34%	-41%
29	Sasaram	BR	-35%	-37%
30	Katihar	BR	-42%	-27%
31	Manguraha	BR	-42%	-38%
32	Samastipur	BR	-47%	-49%
33	Kishanganj	BR	-47%	-44%
34	Munger	BR	-49%	-51%
35	Siwan	BR	-58%	-43%
36	Bettiah	BR	-62%	-56%
37	Bihar Sharif	BR	-73%	-54%

Note: Winter value of a city is based on mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for both 2022-23 and 2023-24 winters. The winter is defined as 1 Oct to 31 Jan.
Source: CSE analysis of CPCB's real time air quality data

Central India

Gwalior and Bhopal in MP are the most polluted cities in the Central: 23 cities in the Central have realtime monitoring and enough data for the winter to carry out air quality analysis. Gwalior with a winter average of 100.1 µg/m^3 and winter peak of 253 µg/m^3 was the most polluted city in the region. Bhopal was the second most polluted in the region with winter average of 81.8 µg/m^3 and winter peak of 227 µg/m^3. 10 most polluted cities in the region are all located MP (see *Table 8: Winter air quality among cities of Central India 2023-24*). Bhilai is the most polluted city in Chhattisgarh with winter average of 52.6 µg/m^3 and winter peak of 125 µg/m^3. Satna, Damoh and Korba registered the lowest winter average in the region but accuracy of their data is doubtful as it doesn't show seasonal variation in $PM_{2.5}$ levels as seen in the region, field investigation needed to verify their data was beyond the scope of this study.

Table 8: Winter air quality among cities of Central India 2023-24

	City	State	Winter average	Winter peak
1	Gwalior	MP	100.1	253
2	Bhopal	MP	81.8	227
3	Indore	MP	76.9	193
4	Ujjain	MP	75.3	157
5	Katni	MP	73.8	162
6	Singrauli	MP	69.3	151
7	Pithampur	MP	67.7	119
8	Dewas	MP	67.7	128
9	Jabalpur	MP	67.0	178
10	Mandideep	MP	63.7	140
11	Ratlam	MP	53.1	126
12	Bhilai	CG	52.6	125
13	Sagar	MP	46.8	121
14	Bilaspur	CG	43.8	105
15	Raipur	CG	43.1	84
16	Tumidih	CG	41.2	92
17	Chhal	CG	39.7	84
18	Maihar	MP	39.4	83
19	Kunjemura	CG	33.1	81
20	Milupara	CG	29.0	70
21	Korba	CG	22.5	45
22	Damoh	MP	22.4	44
23	Satna	MP	21.5	38

Note: Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3.
Source: CSE analysis of CPCB's real time air quality data

Indore and Bilaspur registered the steepest increase in pollution in the Central: 16 cities in the North have realtime monitoring and enough data for both winters to carry out trend analysis. 10 of these 16 cities registered an increase in their winter $PM_{2.5}$ level compared to the previous winter. Indore registered a 110 per cent increase that is by far the steepest increase in the region (see *Table 9: Trend in winter air quality among cities of Central India 2022-23 vs 2023-24*). Bilaspur registered a 65 per cent increase and Maihar registered a 62 per cent increase. Among major cities Bhopal registered 3 per cent increase and Gwalior registered 21 per cent decrease. Singrauli, Damoh and Jabalpur registered improvement in access of 25 per cent.

Table 9: Trend in winter air quality among cities of Central India 2022-23 vs 2023-24

	City	State	Change in winter average	Change in winter peak
1	Indore	MP	110%	45%
2	Bilaspur	CG	65%	8%
3	Maihar	MP	62%	50%
4	Dewas	MP	36%	39%
5	Mandideep	MP	28%	15%
6	Satna	MP	8%	-16%
7	Pithampur	MP	4%	0%
8	Sagar	MP	4%	-13%
9	Bhopal	MP	3%	30%
10	Ratlam	MP	1%	-23%
11	Ujjain	MP	-3%	-57%
12	Gwalior	MP	-21%	-24%
13	Katni	MP	-21%	-13%
14	Jabalpur	MP	-26%	-15%
15	Damoh	MP	-44%	-45%
16	Singrauli	MP	-44%	-34%

Note: Winter value of a city is based on mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for both 2022-23 and 2023-24 winters. The winter is defined as 1 Oct to 31 Jan.
Source: CSE analysis of CPCB's real time air quality data

West India

Vapi and Ulhasnagar are the most polluted cities in the West: 38 cities in the West have realtime monitoring and enough data for the winter to carry out air quality analysis. Vapi in Gujarat with a winter average of 88.8 µg/m^3 and winter peak of 151 µg/m^3 was the most polluted city in the region. Ulhasnagar in Maharashtra was the second most polluted in the region with a winter average of 84.2 µg/m^3 and winter peak of 210 µg/m^3. Pimpri Chinchwad, Chandrapur, Badlapur and Bhiwandi with average above 75 µg/m^3 are other high pollution cities in the region (see *Table 10: Winter air quality among cities of West India 2023-24*). Among other major cities Navi Mumbai registered winter average of 71.2 µg/m^3 and winter peak of 118 µg/m^3, Surat registered winter average of 69.2 µg/m^3 and winter peak of 296 µg/m^3, Ahmedabad registered winter average of 61.2 µg/m^3 and winter peak of 128 µg/m^3, and Mumbai registered winter average of 60.6 µg/m^3 and winter peak of 112 µg/m^3. Gandhinagar and Kalyan were the cleanest in the region with winter average under 45 µg/m^3.

Table 10: Winter air quality among cities of West India 2023-24

	City	State	Winter average	Winter peak
1	Vapi	GJ	88.8	151
2	Ulhasnagar	MH	84.2	210
3	Pimpri Chinchwad	MH	80.4	180
4	Chandrapur	MH	77.9	320
5	Badlapur	MH	75.9	166
6	Bhiwandi	MH	75.2	119
7	Ankleshwar	GJ	74.9	119
8	Nagpur	MH	74.3	137
9	Dhule	MH	73.3	161
10	Navi Mumbai	MH	71.2	118
11	Aurangabad	MH	70.9	171
12	Surat	GJ	69.2	296
13	Jalgaon	MH	68.0	163
14	Mira	MH	67.4	126
15	Akola	MH	66.6	193
16	Pune	MH	64.4	156
17	Solapur	MH	64.2	132
18	Amravati	MH	62.1	136
19	Parbhani	MH	61.2	128
20	Ahmedabad	GJ	61.2	128
21	Nashik	MH	60.6	137
22	Mumbai	MH	60.6	112
23	Virar	MH	60.1	106
24	Sangli	MH	59.6	114
25	Mahad	MH	58.7	101
26	Latur	MH	58.6	122
27	Vatva	GJ	58.0	133
28	Thane	MH	57.7	111
29	Malegaon	MH	57.2	93
30	Jalna	MH	56.1	160
31	Nanded	MH	55.7	95

	City	State	Winter average	Winter peak
32	Kolhapur	MH	53.5	94
33	Gandhinagar	GJ	52.3	97
34	Belapur	MH	49.6	95
35	Ahmednagar	MH	48.9	112
36	Vasai	MH	46.5	85
37	Kalyan	MH	44.3	78
38	Gandhinagar	GJ	39.1	126

Note: Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3.
Source: CSE analysis of CPCB's real time air quality data

Aurangabad and Gandhinagar registered the steepest increase in pollution in the West: 15 cities in the North have realtime monitoring and enough data for both winters to carry out trend analysis. 5 of these 15 cities registered an increase in their winter $PM_{2.5}$ level compared to the previous winter. Aurangabad registered a 23 per cent increase that is by far the steepest increase in the region (see *Table 11: Trend in winter air quality among cities of West India 2022-23 vs 2023-24*). Gandhinagar registered 11 per cent increase and Chandrapur registered 8 per cent increase. Among major cities Ahmedabad registered 6 per cent increase and Mumbai registered 20 per cent decrease. Surat and Kalyan registered an improvement in access of 30 per cent.

Table 11: Trend in winter air quality among cities of West India 2022-23 vs 2023-24)

	City	State	Change in winter average	Change in winter peak
1	Aurangabad	MH	23%	35%
2	Gandhinagar	GJ	11%	-26%
3	Chandrapur	MH	8%	77%
4	Ahmedabad	GJ	6%	-67%
5	Nashik	MH	2%	18%
6	Vatva	GJ	-5%	-38%
7	Ankleshwar	GJ	-10%	-12%
8	Vasai	MH	-10%	2%
9	Gandhinagar	GJ	-11%	-4%
10	Nagpur	MH	-11%	-23%
11	Mumbai	MH	-20%	-24%
12	Vapi	GJ	-26%	-27%
13	Navi Mumbai	MH	-29%	-53%
14	Kalyan	MH	-30%	-38%
15	Surat	GJ	-37%	57%

Note: Winter value of a city is based on mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for both 2022-23 and 2023-24 winters. The winter is defined as 1 Oct to 31 Jan.
Source: CSE analysis of CPCB's real time air quality data

South India

Gummidipoondi and Visakhapatnam are the most polluted cities in the South: 46 cities in the South have realtime monitoring and enough data for the winter to carry out air quality analysis. Gummidipoondi in Tamil Nadu with a winter average of 83.4 µg/m^3 and a winter peak of 191 µg/m^3 was the most polluted city in the region. Visakhapatnam was the second most polluted in the region with a winter average of 73.3 µg/m^3 and winter peak of 156 µg/m^3. Bidar is the most polluted city in Karnataka with winter average of 60.1 µg/m^3 and winter peak of 100 µg/m^3. Kollam was the most polluted city in Kerala (see *Table 12: Winter air quality among cities of South India 2023-24*). Among other major cities Hyderabad registered winter average of 43.6 µg/m3 and winter peak of 99 µg/m^3, Bengaluru registered winter average of 41.3 µg/m^3 and winter peak of 92 µg/m^3, Chennai registered winter average of 36.5 µg/m^3 and winter peak of 146 µg/m^3, and Thiruvananthapuram registered winter average of 29.5 µg/m^3 and winter peak of 118 µg/m^3. Chamarajanagar, Vijaypura and Kalaburagi in Karnataka were the cleanest in the region with winter average under 20 µg/m^3.

Table 12: Winter air quality among cities of South India 2023-24

	City	State	Winter average	Winter peak
1	Gummidipoondi	TN	83.4	191
2	Visakhapatnam	AP	73.3	156
3	Rajamahendravaram	AP	65.4	143
4	Bidar	KA	60.1	100
5	Amaravati	AP	55.9	109
6	Kollam	KL	50.5	131
7	Haveri	KA	46.7	110
8	Yadgir	KA	46.6	97
9	Chittoor	AP	46.1	207
10	Chikkaballapur	KA	45.0	84
11	Tumakuru	KA	44.9	105
12	Hyderabad	TS	43.6	99
13	Salem	TN	43.1	84
14	Mangalore	KA	42.5	100
15	Bengaluru	KA	41.3	92
16	Davanagere	KA	41.1	100
17	Tirupati	AP	38.8	101
18	Hassan	KA	37.7	63
19	Chennai	TN	36.5	146
20	Ramnagara	KA	36.5	78
21	Vijaywada	AP	36.1	72
22	Puducherry	PY	36.0	130
23	Cuddalore	TN	35.0	107
24	Kadapa	AP	32.6	76
25	Kochi	KL	32.3	75
26	Hubballi	KA	31.9	95
27	Thrissur	KL	30.5	31
28	Anantapur	AP	29.7	49
29	Thiruvananthapuram	KL	29.5	118
30	Belgaum	KA	28.9	67

	City	State	Winter average	Winter peak
31	Gadag	KA	28.1	62
32	Kannur	KL	27.8	34
33	Ooty	TN	27.7	60
34	Ramanathapuram	TN	27.0	89
35	Koppal	KA	26.5	53
36	Raichur	KA	26.0	54
37	Mysuru	KA	25.7	44
38	Dharwad	KA	25.5	53
39	Madikeri	KA	25.1	43
40	Chikkamagaluru	KA	25.1	51
41	Shivamogga	KA	24.8	45
42	Bagalkot	KA	22.7	55
43	Ariyalur	TN	21.3	53
44	Kalaburagi	KA	19.4	66
45	Vijaypura	KA	18.6	38
46	Chamarajanagar	KA	18.1	38

Note: Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in $\mu g/m^3$.
Source: CSE analysis of CPCB's real time air quality data

Kollam and Madikera registered the steepest increase in pollution in the South: 36 cities in the South have realtime monitoring and enough data for both winters to carry out trend analysis. 18 of these 36 cities registered an increase in their winter $PM_{2.5}$ level compared to the previous winter. Kollam registered a 51 per cent increase that is by far the steepest increase in the region (see *Table 13: Trend in winter air quality among cities of South India 2022-23 vs 2023-24*). Madikeri registered 33 per cent increase and Chikkamagaluru registered 26 per cent increase. Most cities that register an increase are located in Karnataka. Among major cities Visakhapatnam registered 2 per cent increase, 7 per cent decrease was registered in Bengaluru and Hyderabad each, Chennai registered 15 per cent decrease, and Thiruvananthapuram registered 18 per cent decrease. Kalaburagi, Belgaum and Kochi registered improvement in access of 40 per cent.

Table 13: Trend in winter air quality among cities of South India 2022-23 vs 2023-24

	City	State	Change in winter average	Change in winter peak
1	Kollam	KL	51%	140%
2	Madikeri	KA	33%	-10%
3	Chikkamagaluru	KA	26%	5%
4	Hassan	KA	22%	4%
5	Mysuru	KA	19%	8%
6	Shivamogga	KA	17%	31%
7	Davanagere	KA	16%	39%
8	Yadgir	KA	14%	21%
9	Bagalkot	KA	11%	76%
10	Rajamahendravaram	AP	9%	13%
11	Haveri	KA	8%	23%
12	Amaravati	AP	5%	-10%
13	Gadag	KA	5%	-79%
14	Mangalore	KA	4%	37%
15	Chikkaballapur	KA	2%	-23%
16	Tirupati	AP	2%	-35%

	City	State	Change in winter average	Change in winter peak
17	Visakhapatnam	AP	2%	4%
18	Chamarajanagar	KA	0%	41%
19	Anantapur	AP	-2%	-61%
20	Ramnagara	KA	-5%	-1%
21	Ooty	TN	-5%	7%
22	Raichur	KA	-5%	0%
23	Hyderabad	TS	-7%	35%
24	Bengaluru	KA	-7%	-39%
25	Vijaypura	KA	-10%	37%
26	Puducherry	PY	-14%	-29%
27	Chennai	TN	-15%	11%
28	Koppal	KA	-16%	-45%
29	Thiruvananthapuram	KL	-18%	-42%
30	Ramanathapuram	TN	-19%	-17%
31	Thrissur	KL	-23%	-53%
32	Hubballi	KA	-28%	4%
33	Kannur	KL	-36%	-40%
34	Kochi	KL	-41%	-58%
35	Belgaum	KA	-49%	-41%
36	Kalaburagi	KA	-63%	-33%

Note: Winter value of a city is based on mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for both 2022-23 and 2023-24 winters. The winter is defined as 1 Oct to 31 Jan.
Source: CSE analysis of CPCB's real time air quality data

Northeast India

Byrnihat and Nalbari, both in Assam, are the most polluted city in the Northeast: 11 cities in the East have realtime monitoring and enough data for the winter to carry out air quality analysis. Byrnihat with a winter average of 130.6 µg/m^3 and a winter peak of 278 µg/m^3 was the most polluted city in the region. Nalbari was the second most polluted in the region with a winter average of 101.8 µg/m^3 and winter peak of 238 µg/m^3. Agartala in Tripura is the most polluted city in the region outside Assam with a winter average of 96.4 µg/m^3 and winter peak of 207 µg/m^3 (see *Table 14: Winter air quality among cities of Northeast India 2023-24*). Guwahati registered a winter average of 81.5 µg/m^3 and winter peak of 214 µg/m^3. Kohima, Shillong, Imphal, Silchar and Gangtok had winter average under 40 µg/m^3.

Table 14: Winter air quality among cities of Northeast India 2023-24

	City	State	Winter average	Winter peak
1	Byrnihat	AS	130.6	278
2	Nalbari	AS	101.8	238
3	Agartala	TR	96.4	207
4	Guwahati	AS	81.5	214
5	Sivasagar	AS	61.7	247
6	Nagaon	AS	48.9	191
7	Kohima	NL	36.8	71
8	Shillong	ML	34.8	123
9	Imphal	MN	34.6	113
10	Silchar	AS	14.9	26
11	Gangtok	SK	9.8	20

Note: Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3.
Source: CSE analysis of CPCB's real time air quality data

Kohima and Agartala registered the steepest increase in pollution in the Northeast: 7 cities in the Northeast have realtime monitoring and enough data for both winters to carry out trend analysis. 2 of these 7 cities registered an increase in their winter $PM_{2.5}$ level compared to the previous winter (see *Table 15: Trend in winter air quality among cities of Northeast India 2022-23 vs 2023-24*). Kohima registered a 21 per cent increase and Agartala registered a 10 per cent increase. Among major cities Shillong registered 2 per cent decrease, Guwahati registered 4 per cent decrease, Imphal registered 15 per cent decrease and Gangtok registered 70 per cent decrease.

Table 15: Trend in winter air quality among cities of Northeast India 2022-23 vs 2023-24

	City	State	Change in winter average	Change in winter peak
1	Kohima	NL	21%	-14%
2	Agartala	TR	10%	-11%
3	Shillong	ML	-2%	47%
4	Guwahati	AS	-4%	-9%
5	Imphal	MN	-15%	-42%
6	Nalbari	AS	-20%	2%
7	Gangtok	SK	-70%	-82%

Note: Winter value of a city is based on mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for both 2022-23 and 2023-24 winters. The winter is defined as 1 Oct to 31 Jan. Source: CSE analysis of CPCB's real time air quality data