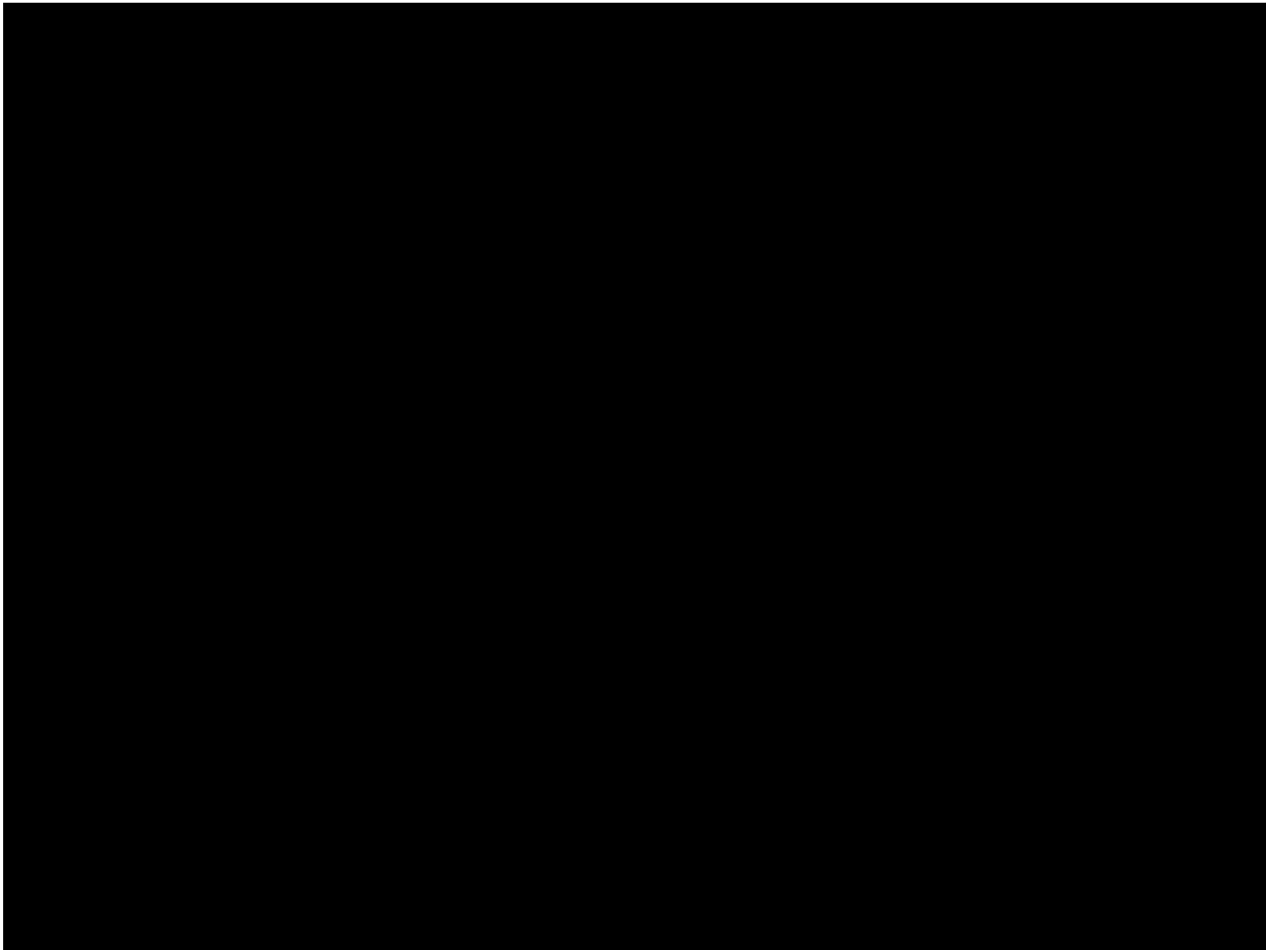


Air Quality Issues of Kolkata

Ujjal Kumar Mukhopadhyay

National Ambient Air Quality Standard 2009

Sulphur Dioxide (SO_2), $\mu g/m^3$	Annual*	50	20
	24 Hours**	80	80
Nitrogen Dioxide (NO_2), $\mu g/m^3$	Annual*	40	30
	24 Hours**	80	80
Ozone (O_3), $\mu g/m^3$	8 Hours**	100	100
	1 Hours**	180	180
Carbon Monoxide (CO), mg/m^3	8 Hours*	02	02
	1 Hour**	04	04
Ammonia (NH_3), $\mu g/m^3$	Annual*	100	100
	24 Hours**	400	400
Benzene ($C_6 H_6$), $\mu g/m^3$	Annual*	05	05

National Ambient Air Quality Standard 2009

Particulate Matter (size less than 10 µm) or PM10, µg/m3	Annual*	60	60
	24 Hours**	100	100
Particulate Matter (size less than 2.5 µm) or PM2.5, µg/m3	Annual*	40	40
	24 Hours**	60	60
Lead (Pb), µg/m3	Annual*	0.5	0.5
	24 Hours**	1.0	1.0
Benz(α)Pyrene (BaP) – Particulate Phase Only, ng/m3	Annual*	01	01
Arsenic (As), ng/m3	Annual*	06	06
Nickel (Ni), ng/m3	Annual*	20	20

Air quality monitoring stations in 2015

During 2013-2015, air quality of Kolkata was monitored at 11 stations.

Stations			Parameters monitored
Kolkata	1.	Dunlop Bridge	PM10, SO2, NO2,
	2.	Behala Chowrasta	PM10, PM2.5, SO2, NO2, CO, C6H6, O3, NH3, As, PAH, Pb, Ni
	3.	Salt Lake	PM10, SO2, NO2
	4.	Baishnabghata	PM10, SO2, NO2
	5.	Ultadanga	PM10, PM2.5, SO2, NO2
	6.	Moulali	PM10, SO2, NO2
	7.	Shyambazar	PM10, PM2.5, SO2, NO2, CO, C6H6, O3, NH3, As, PAH, Pb, Ni
	8.	Minto Park	PM10, PM2.5, SO2, NO2
	9.	Paribesh Bhawan	PM10, SO2, NO2
	10.	Rabindrabharati University	PM10, SO2, NO2, CO, Benzene, O3
	11.	Victoria Memorial	PM10, SO2, NO2, CO, Benzene, O3

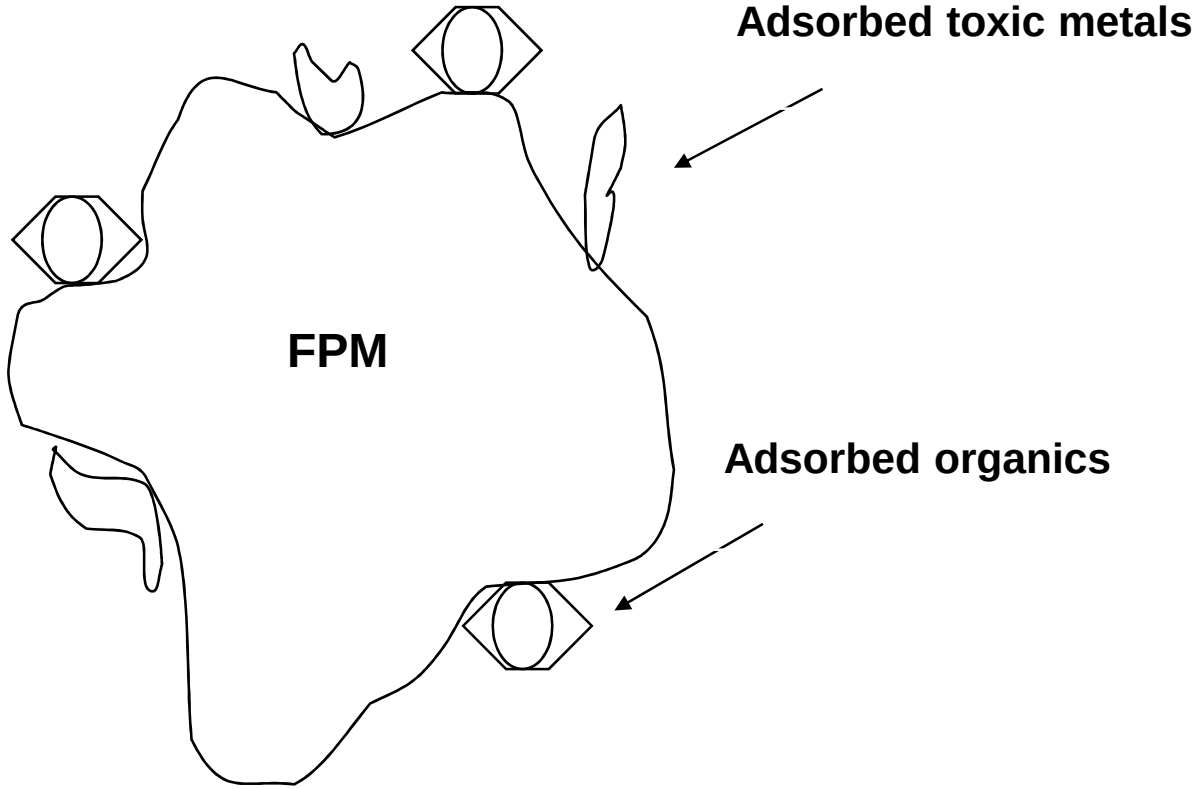
Air quality data (2013-2015) analysis

Annual Average of Air Pollutants in Kolkata (data from manual stations)						
Year	Lead (mg/m^3)	NH3 (mg/m^3)	Benzene (mg/m^3)	B(a)P (ng/m^3)	As (ng/m^3)	Ni (ng/m^3)
2013	0.21	16.42	0.85	0.19	3.04	6.56
2014	0.17	14.00	0.83	0.44	2.33	7.24
2015 (till NOV)	0.17	17.71	0.74	0.30	2.72	6.91
NAAQ Standard (Annual Average)	0.5	100	5	1	6	20

Kolkata situation of Pollutants Not Having Annual Average Standard (data from manual stations)		
Year	Ozone (mg/m^3)	Carbon Monoxide, CO (mg/m^3)
2013	No violation of standard	No violation of standard
2014	No violation of standard	No violation of standard
2015 (till NOV)	No violation of standard	2 times (On 11 NOV 2015, 2300 – 2400) (On 12 NOV 2015, 0000 – 0100)
NAAQ Standard (Every Hour)	180	4

Air quality data (2013-2015) analysis

Annual Average of Air Pollutants in Kolkata (data from manual stations)				
Year	**PM10 (µg/m³)**	**PM2.5 (µg/m³)**	**SO2 (µg/m³)**	**NO2 (µg/m³)**
2013	121.3	68.2	7.9	43.0
2014	129.2	70.1	5.6	45.9
2015 (till NOV)	106.3	56.6	3.9	43.4
NAAQ Standard (Annual Average)	60	40	50	40


Adsorbed toxic metals
FPM
Adsorbed organics

10 to 5.8 μm	Nasal cavity
5.8 to 4.7 μm	Pharynx
4.7 to 3.3 μm	Primary Bronchi
3.3 to 2.1 μm	Secondary Bronchi
2.1 to 1.1 μm	Terminal Bronchi
1.1 to 0.65 μm	Alveoli
1.1 to 0.43 μm	Alveoli
0.43 & below	Alveoli

Air quality data (2013-2015) analysis

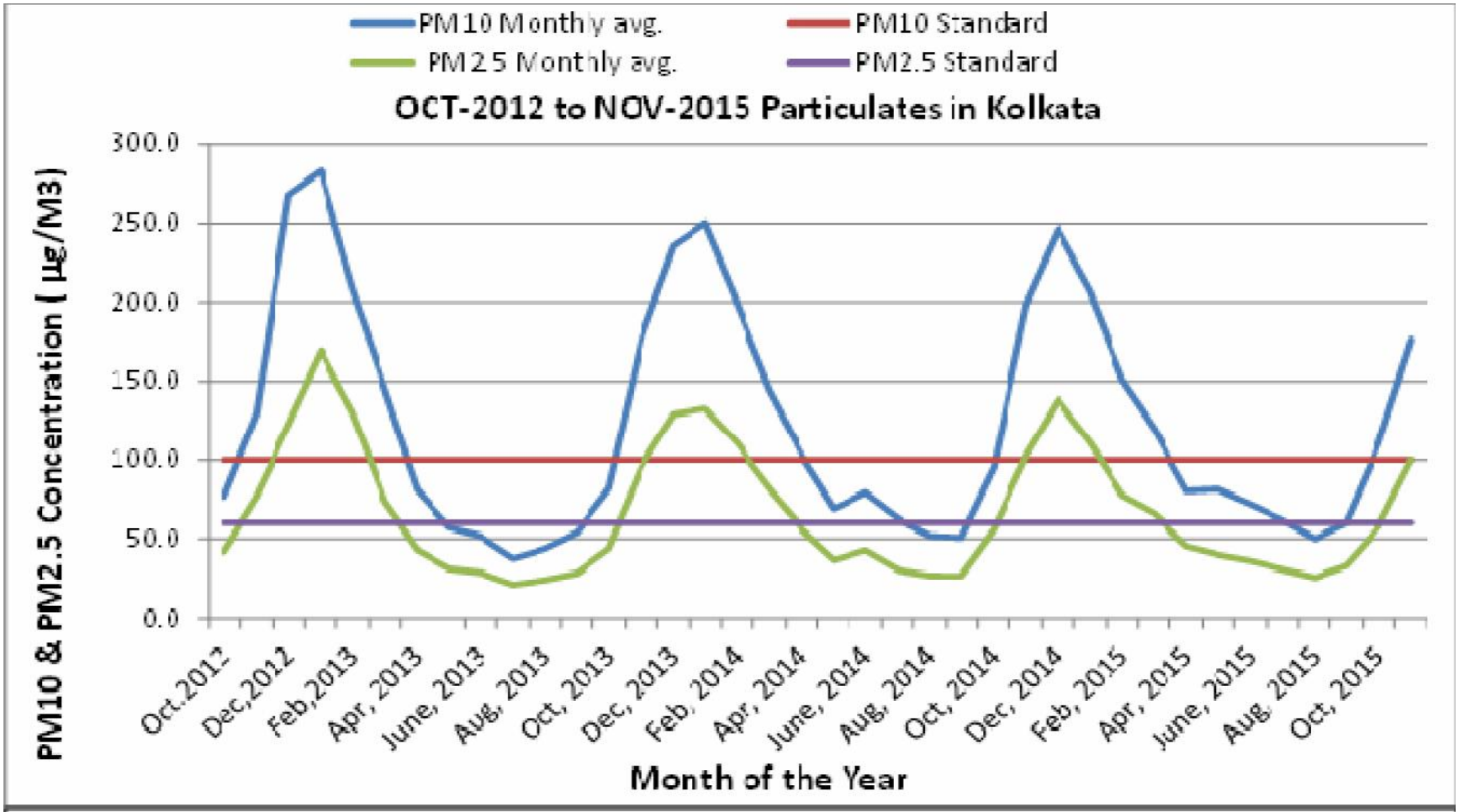


Fig 1. Variation of PM10 and PM2.5 in Kolkata during the period October 2012 to November 2015 in Kolkata city.

Air quality data (2013-2015) analysis

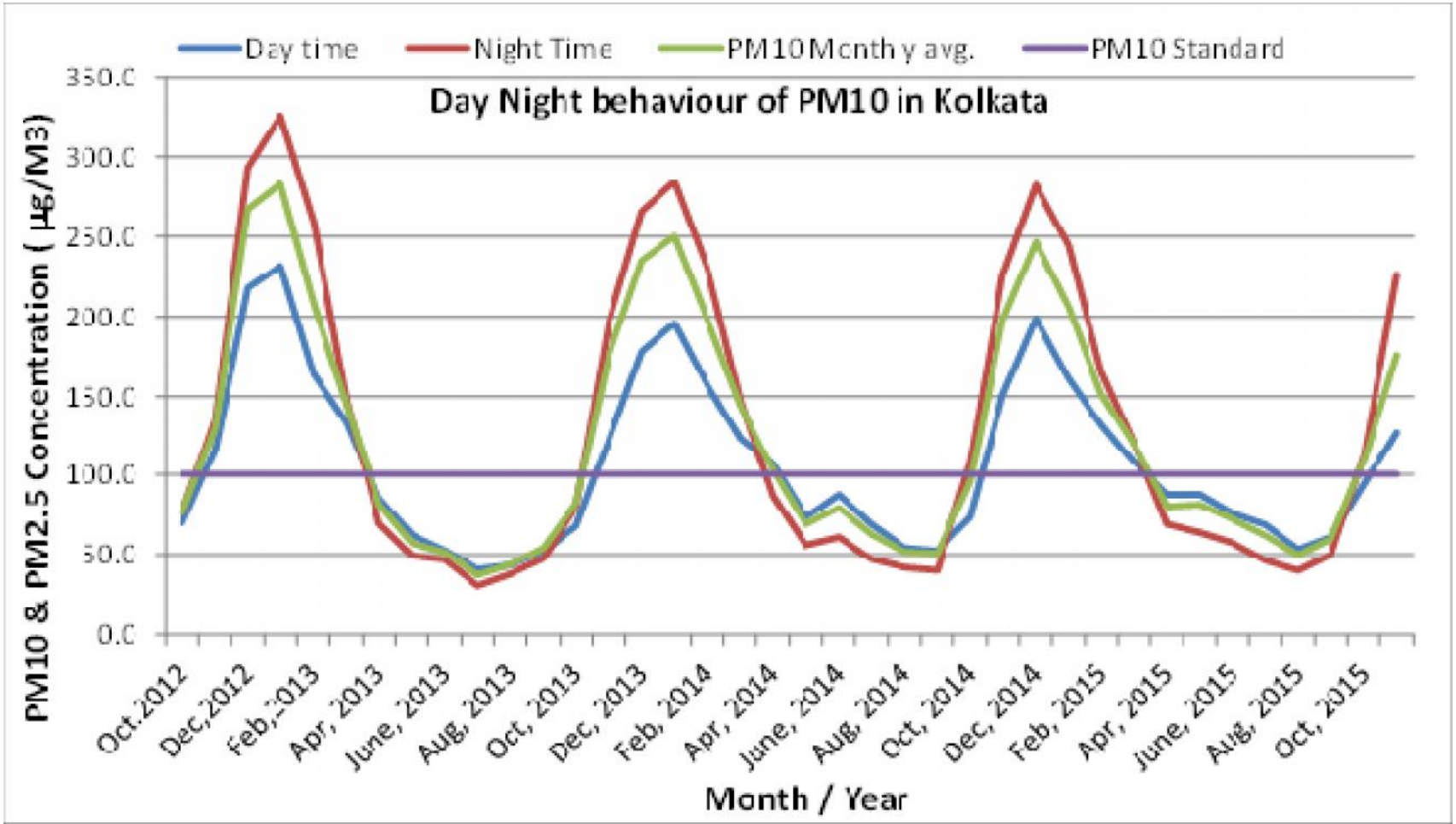


Fig 2. Variation of PM10 concentrations during day time and night time of period Oct 2012 to Nov 2015 in Kolkata city.

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Air quality data (2013-2015) analysis

1. Air quality of Kolkata is non-compliant for pollutants PM2.5, PM10 and NO2.
2. Air quality of Kolkata is compliant for other pollutants like SO2, Ozone, Benz(a)Pyrene, Ammonia, Nickel, Arsenic and Lead, Ozone (O3) and Carbon Monoxide (CO).
3. Air quality of Kolkata behaves uniformly throughout the region and an uniform approach may be taken for addressing the air quality issues for this city
4. During winter season (starting late in October and ending early March), PM2.5 and PM10 level is higher than national standards in Kolkata and Howrah.

Air quality data (2013-2015) analysis

5. Air quality of Kolkata is non-compliant for 24 weeks or a period of 5.5 months every year for PM2.5 and PM10.
6. Air quality of Howrah is non-compliant for 30 weeks or a period of 6.5 months every year for PM2.5 and PM10.
7. In case of NO2, non-compliance period is only 4 weeks (during end of December and end of January).
8. Night time concentrations in Kolkata and Howrah are higher than the day-time concentration in winter time. Phenomena is reversed during the summer months due to weather conditions.
9. Location of 19 air monitoring stations in Kolkata were selected considering traffic density across the twin cities and considering the standard for identification of locations and establishment of ambient air quality monitoring stations published by the Bureau of Indian Standards [IS : 5182 (Part 14), 2000]

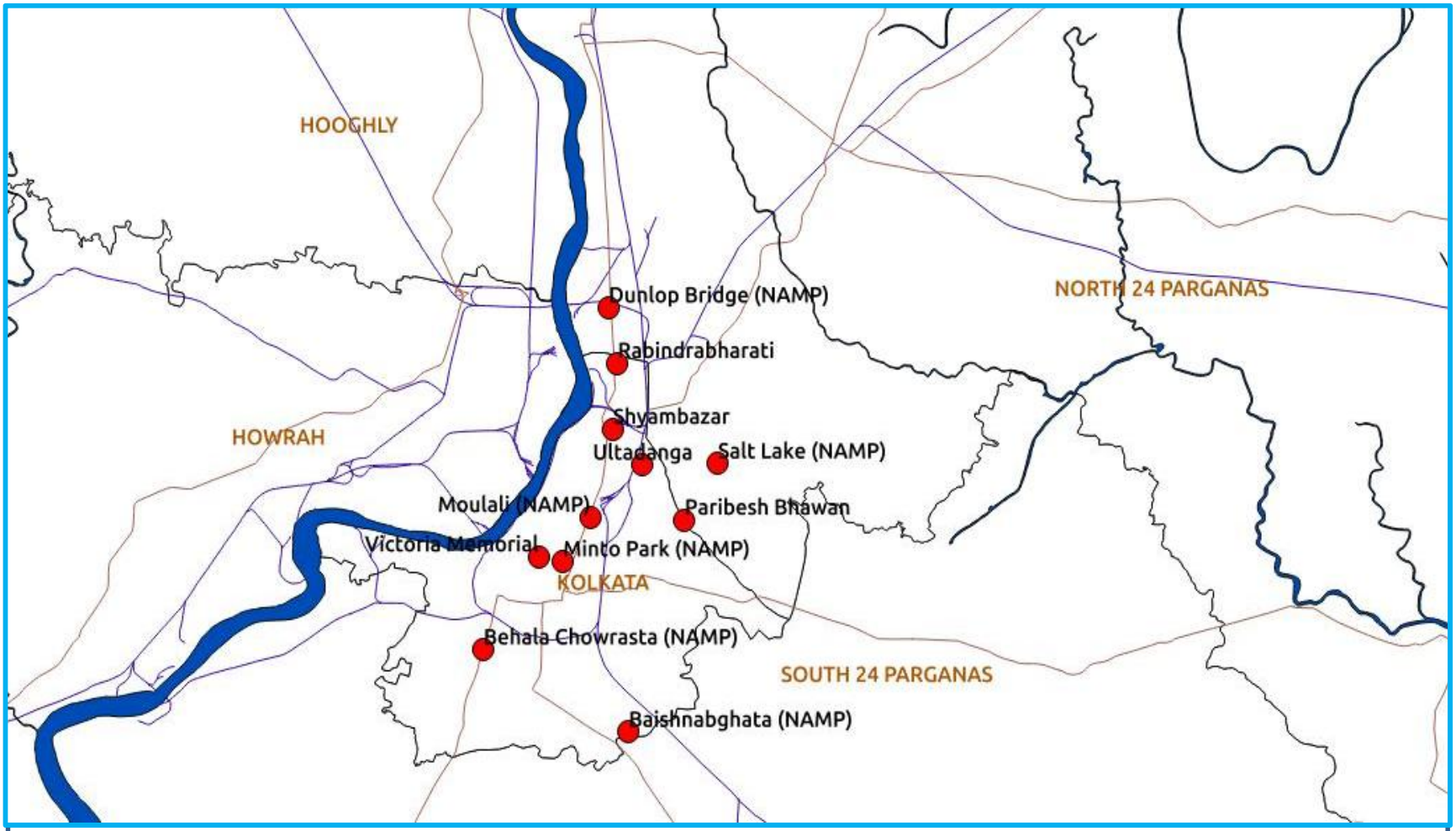
Air Monitoring Stations operating in Kolkata (w.e.f. 01.01.2016)

Kolkata					
1	Dunlop Bridge	11	Mominpore		
2	Picnic Garden	12	Moulali		
3	Tollygunge	13	Shyambazar		
4	Hyde Road	14	Gariahat		
5	Behala Chowrasta	15	Minto Park		
6	Beliaghata	16	Rajarhat		
7	Salt Lake	17	Paribesh Bhawan		
8	Topsia	18	Victoria Memorial		
9	Baishnabghata	19	Rabindrabharati		
10	Ultadanga				

Existing Stations during (2013-2015)

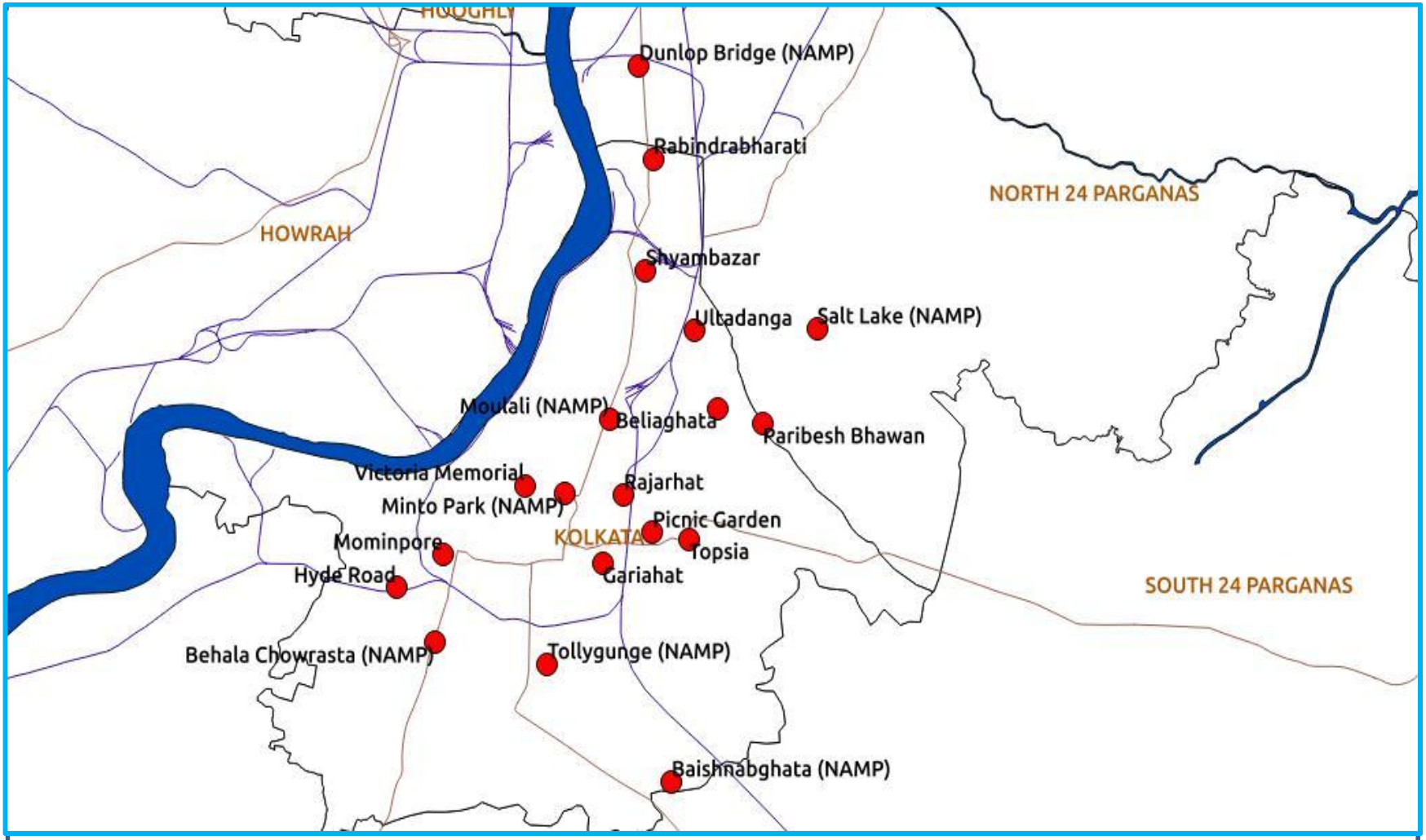
New Stations w.e.f. 01.01.2016

Air Monitoring Stations operated in Kolkata till 31.12.2015



Distribution of air quality monitoring stations in district KOLKATA till 31.12.2015

Air Monitoring Stations operating in Kolkata w.e.f. 01.01.2016



Distribution of air quality monitoring stations in KOLKATA w.e.f. 01.01.2016

Vehicles registered/applied under PVD, Kolkata (01/01/2001-06/01/2016)

Type of vehicle	Number
Private Car + Taxi	329021
Bus	4480
Mini bus + Midi Bus	21496
Tram	0
Auto Rickshaw	14731
Heavy Truck + Light Truck	22780
Van + Others	563
Motor cycles + Scooters	283685
Total	676756

Traffic density analysis

Traffic movement data at 11 crossings in Southern section, 22 in Central section and 17 in Northern section of Kolkata were analyzed

SECTION	Private car+taxi	Bus	Mini bus + midi Bus	Tram / Trailer	Auto Rickshaw	Heavy truck + light truck	Van + others	Motor cycles + scooters	Total
SOUTH	265987	106081	22194	14391	86521	27579	28841	44191	595785
% value	45	18	4	2	15	5	5	7	100
Contribution from Private Car + Taxi + Bus + AutoRickshaw = 77 %									
CENTRAL	788058	249521	48657	25240	57447	32698	45108	101791	1374777
% value	58	19	4	2	4	2	3	8	100
Contribution from Private Car + Taxi + Bus + AutoRickshaw = 81 %									
NORTH	267347	150253	28230	12264	101739	45834	40125	45186	697069
% value	39	22	4	2	15	7	6	7	100
Contribution from Private Car + Taxi + Bus + AutoRickshaw = 75 %									

In Kolkata major contributions on road are from Passenger carriers, both private and commercial.

Traffic density vis-à-vis Air monitoring stations

Traffic Load at Important Road Junctions in Kolkata & nearest AAQM Station			
Sl.	Road Crossing	Load (Daily Average)	Nearest AAQM Station
1	Deshapriya Park	66142	Gariahat
2	Jadavpur PS	71207	Tollygunge & Baishnabghata
3	Rashbihari	79111	Gariahat & Tollygunge
4	Moulali	65150	Moulali
5	Exide Crossing	65575	Minto Park & Victoria Memorial
6	Race Course Crossing	69292	Victoria Memorial
7	Fort Willium	71846	Victoria Memorial
8	Rose Garden	89764	Victoria Memorial
9	DL Khan Crossing	96235	Victoria Memorial
10	Sealdah-NRS	106468	Moulali
11	Park Circus	156036	Topsia
12	Shyambazar	85921	Shyambazar
Traffic Load at Important Road Junctions in Howrah & nearest AAQM Station			
Sl.	Road Crossing	Load (Daily Average)	Nearest AAQM Station
1	Kona Expressway	50693	Bator & Bandhaghat
2	Banstala Ghat	32883	Ghusuri

Auto Emission Testing Centres (PUC Centres)

- WBPCB and Transport Dept. conduct joint inspections of the PUC Centres at the time of renewal of licenses by transport authorities.
- WBPCB sends its recommendations to the competent authorities for consideration of renewal of license of PUC Centres, on merit.
- WBPCB independently inspects PUC Centres in case new application forwarded by the Transport Department.
- No. of PUC centres in Kolkata and Howrah as on 31.12.2015:

Kolkata under PVD	67
Howrah	66
Total PUC's	133

- No. of emission test conducted by AETCs under PVD

Total no. of petrol driven vehicles tested	33114 per month (approx.)
Total no. of diesel driven vehicles tested	10420 per month (approx.)
(Ref: Record supplied by Auto Emission Testers Association, Kolkata)	

Programmes Immediate Ahead

1. Requirement of additional air monitoring stations

(a) Installation of three (3) additional continuous air monitoring stations at near Science City, near Ballygunge Phanri and Sector-V, all with both PM10 and PM2.5 sensors.

(b) Arrangement for continuous monitoring of PM2.5 at Victoria Memorial & Rabindrabharati University.

(c) Source Apportionment Study is to be carried out to chalk out strategies for abatement of pollution as apart from the direct contribution from the tale-pipe emission of vehicles, re-suspension of road dust has got a direct correlation to the amount of particulate air pollution in the urban air.

Programmes Ahead

2. Proper movement of vehicles in high pollution contributing routes

(a) Phasing out / scrapping of commercial vehicles that are more than 15 years old as per the order of Hon'ble Calcutta High Court.

(b) Traffic re-engineering to remove congestion from densely populated/most frequented road

(c) Operationalisation of E-Rickshaws and E-Carts as the mode of transport for last mile connectivity.

(d) Strict enforcement of No Parking Rules and compounding of offences committed.

Programmes Ahead

(e) Construction of multi-layered or underground car parking space.

(f) Coupling of underground or multitier parking arrangement within the premises while sanctioning building plans for Malls etc.

(g) Construction of pavements for all city streets to increase space for smooth traffic movement.

(h) Provision of cycling and walk ways throughout the city.

Programmes to be implemented with immediate effect

(a) Banning on burning of coal and wood in the city.

(b) Strict implementation of direction issued by Department of Environment, Govt. of West Bengal for controlling air pollution generated due to construction activity in projects having more than 500 sq. mtrs.

(c) Complete banning of burning of solid waste including dry leaves in the city areas.

(d) Plantation of new leafy saplings at the available space in different parts of the twin cities to mitigate the level of air pollution.

(e) Replacement of open vats by compactors which have contributed to the improvement in ambient air quality.

Two Issues Need Special Mention

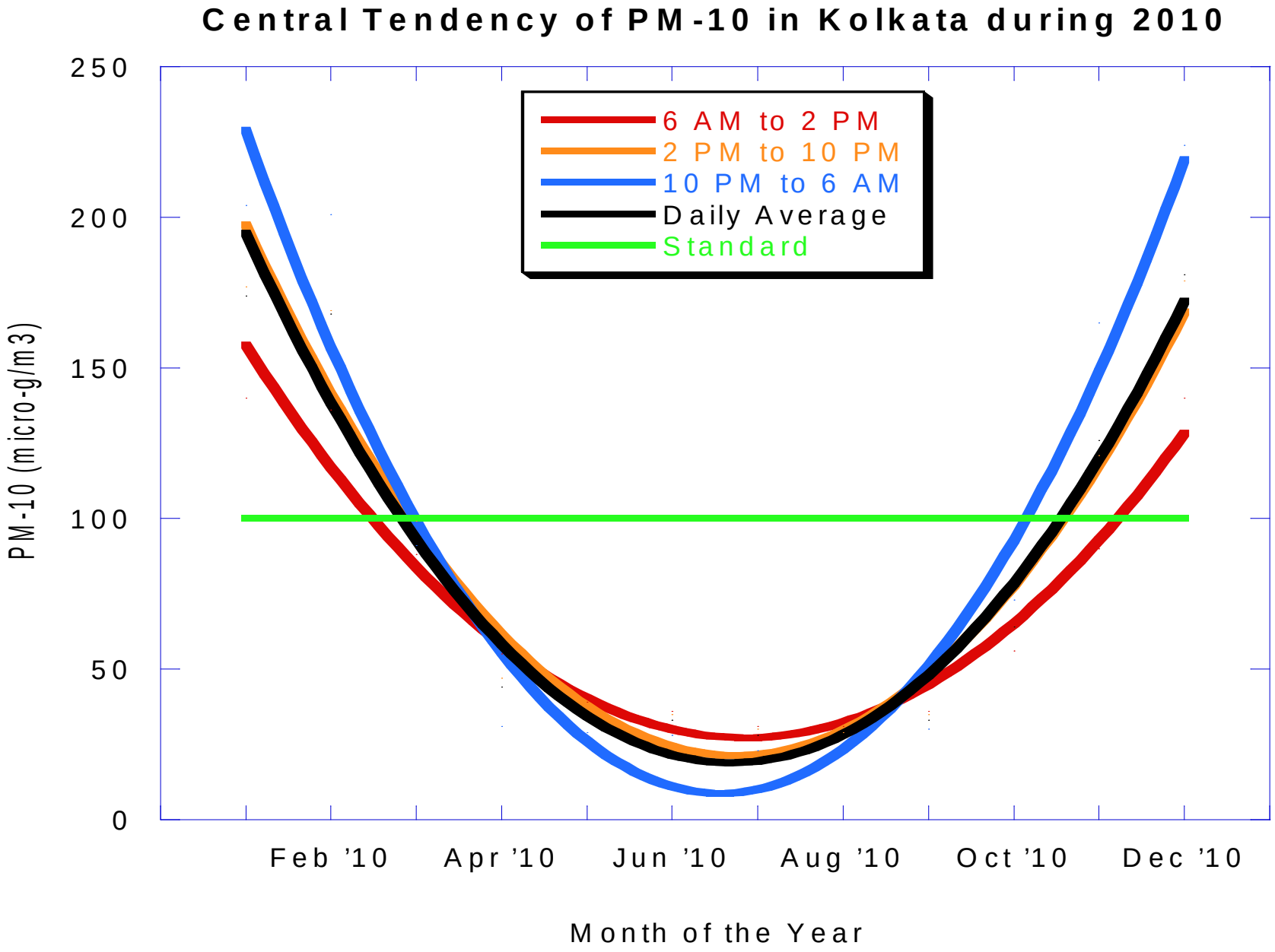
Weather Condition

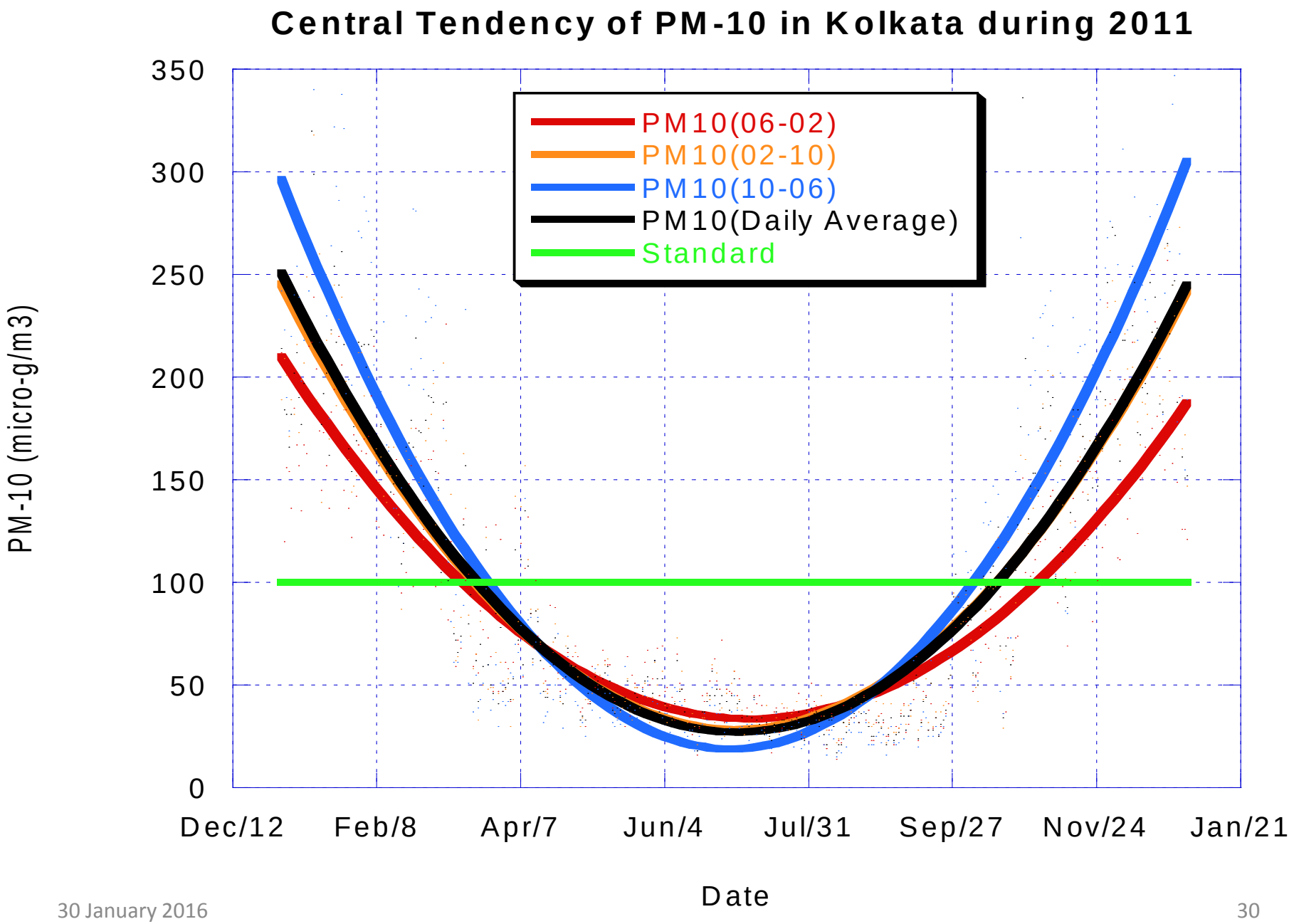
Comparison

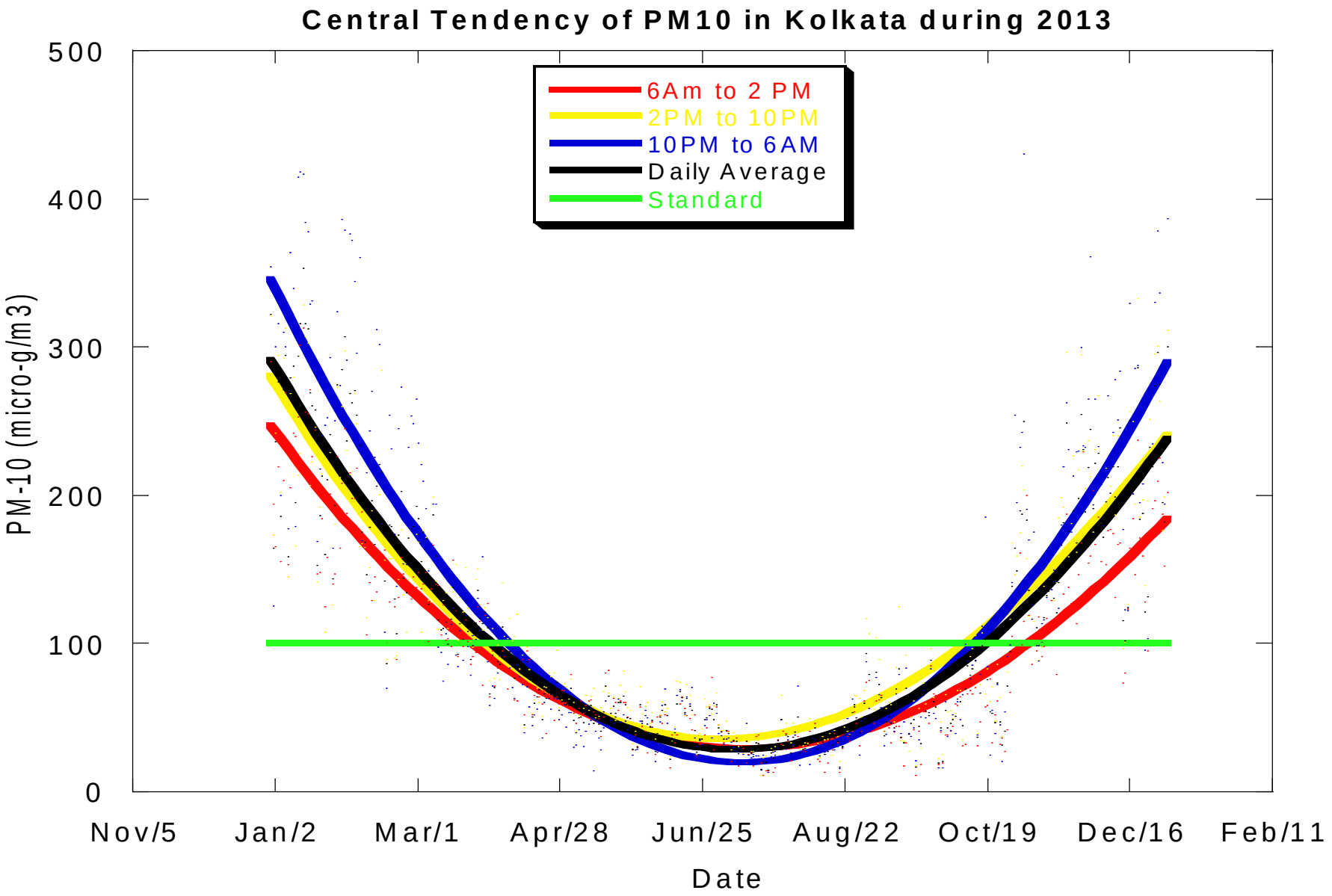
Dispersion – vertical and horizontal

Dispersion – vertical

No Dispersion – It Is INVERSION


Central Tendency of PM-10 in Kolkata during 2010
250
200
150
100
50
0
PM-10 (micro-g/m3)
6 AM to 2 PM
2 PM to 10 PM
10 PM to 6 AM
Daily Average
Standard
Feb '10
Apr '10
Jun '10
Aug '10
Oct '10
Dec '10
Month of the Year


Central Tendency of PM-10 in Kolkata during 2011
PM10(06-02)
PM10(02-10)
PM10(10-06)
PM10(Daily Average)
Standard
PM-10 (micro-g/m3)
350
300
250
200
150
100
50
0
Dec/12
Feb/8
Apr/7
Jun/4
Jul/31
Sep/27
Nov/24
Jan/21
Date


Central Tendency of PM10 in Kolkata during 2013
6Am to 2 PM
2PM to 10PM
10PM to 6AM
Daily Average
Standard
PM-10 (micro-g/m3)
500
400
300
200
100
0
Nov/5
Jan/2
Mar/1
Apr/28
Jun/25
Aug/22
Oct/19
Dec/16
Feb/11
Date

Air quality data (2013-2015) analysis

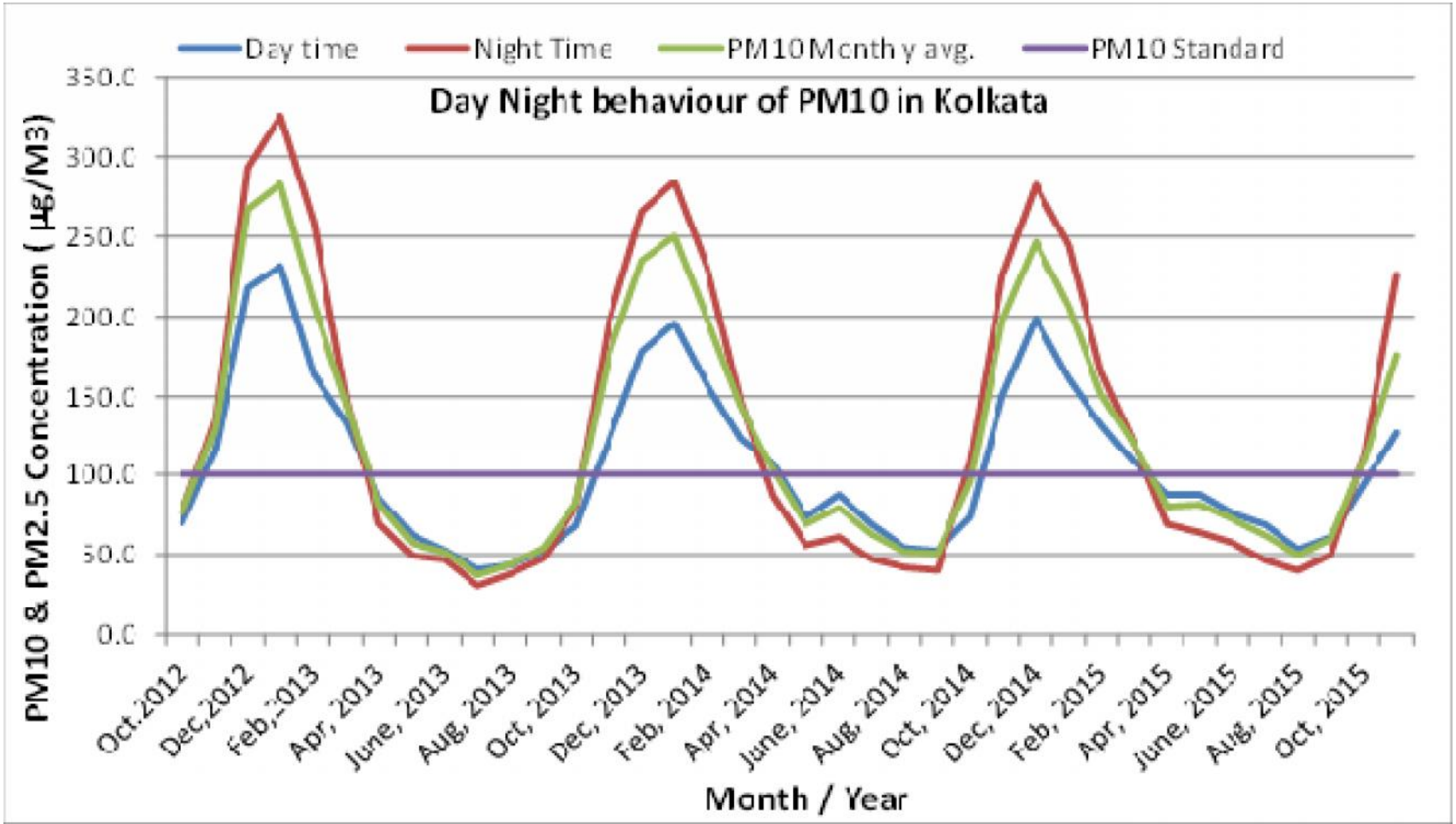


Fig 2. Variation of PM10 concentrations during day time and night time of period Oct 2012 to Nov 2015 in Kolkata city.

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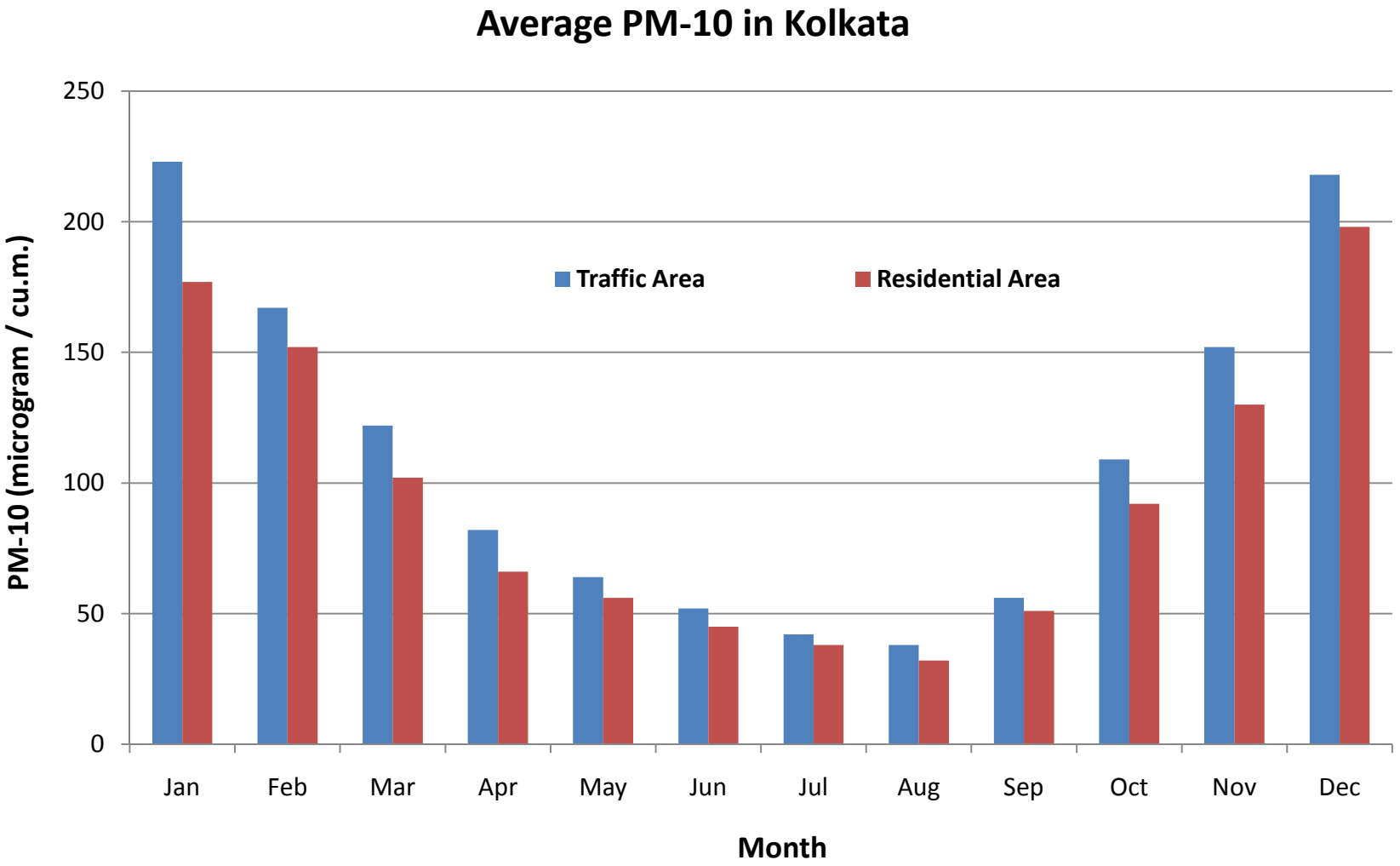
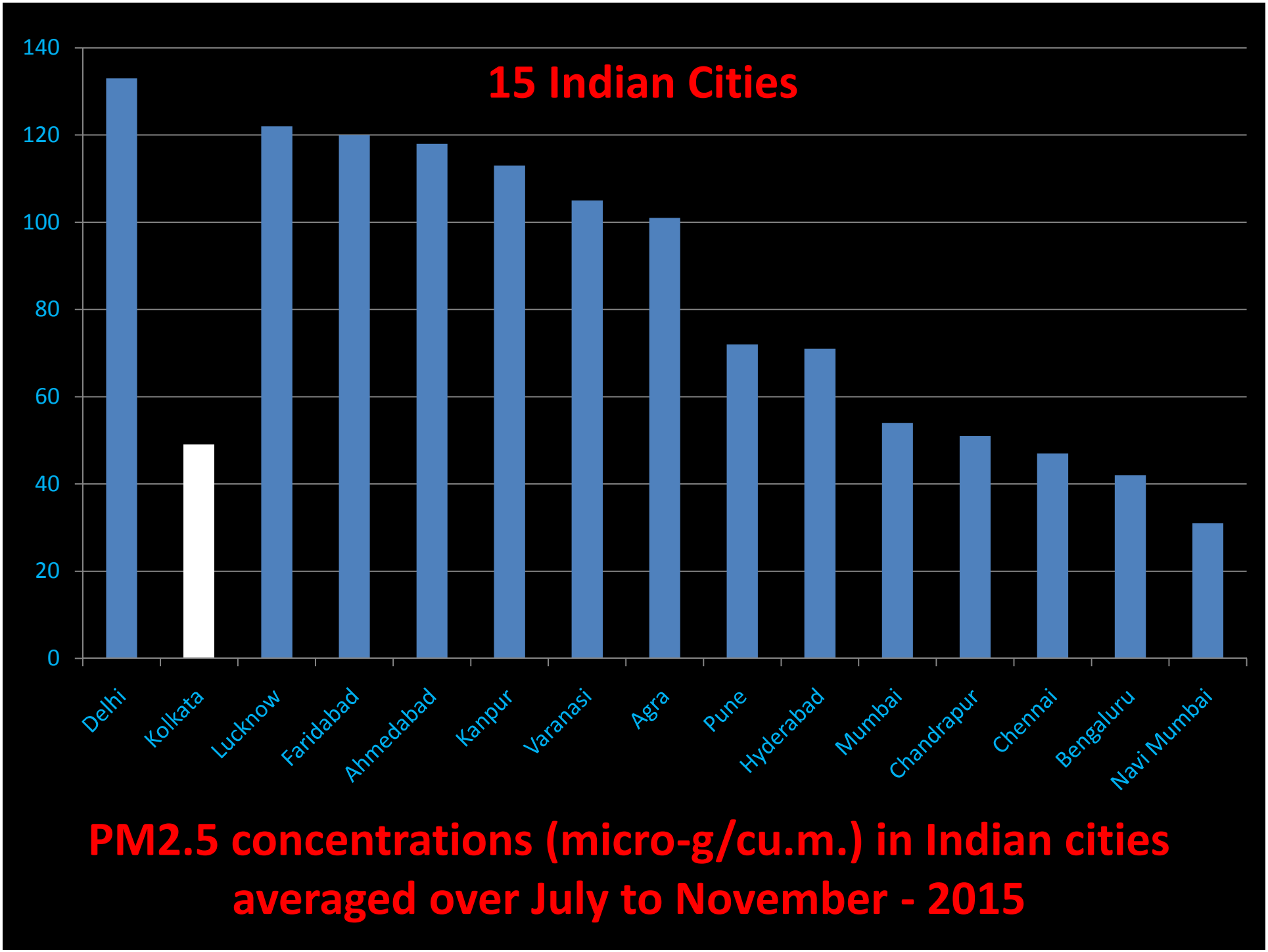
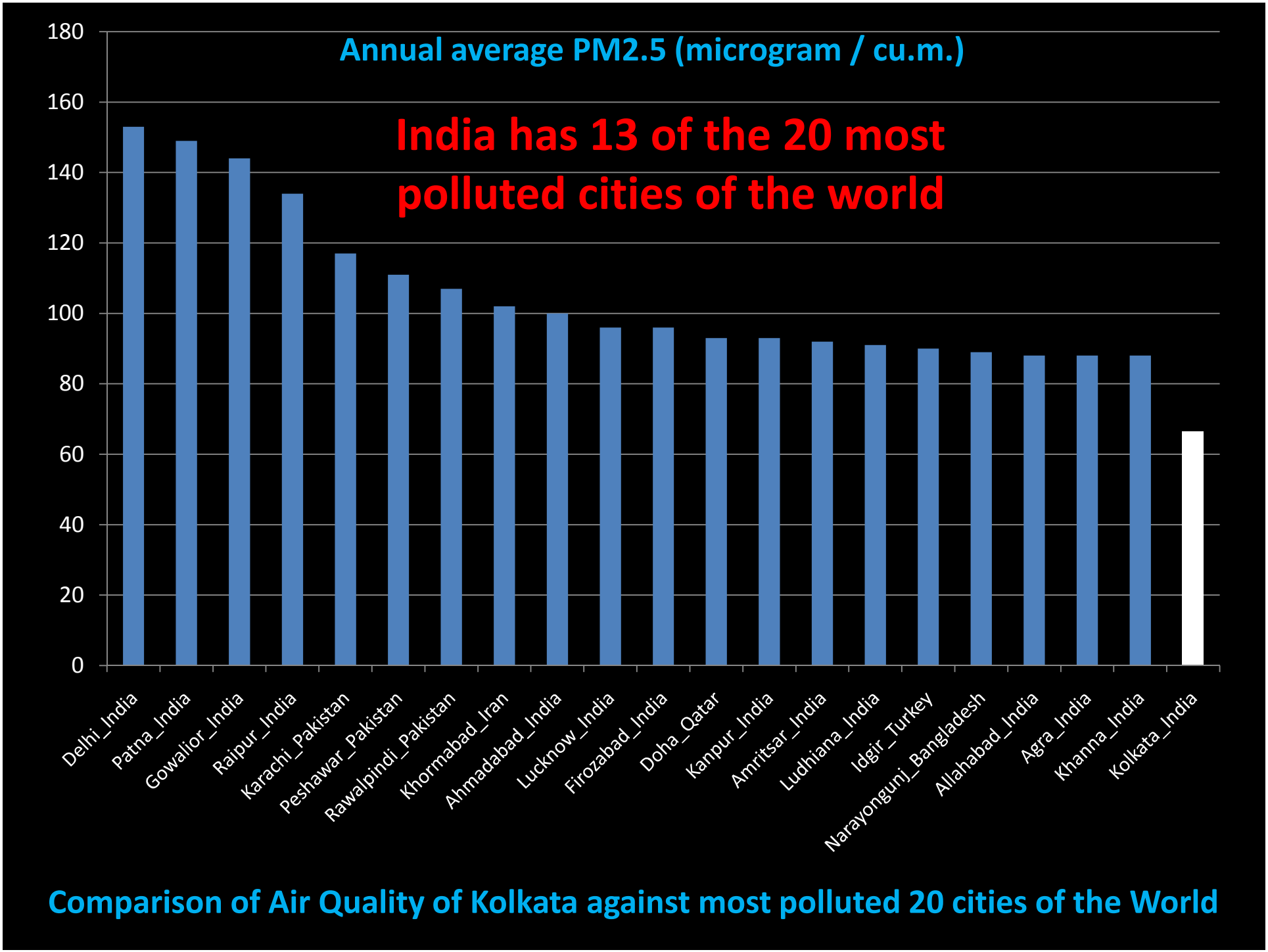


PM-10, the respirable fraction of the suspended air particulates in Kolkata Air. Data presented is averaged over last 7 years.


15 Indian Cities
140
120
100
80
60
40
20
0
Delhi
Kolkata
Lucknow
Faridabad
Ahmedabad
Kanpur
Varanasi
Agra
Pune
Hyderabad
Mumbai
Chandrapur
Chennai
Bengaluru
Navi Mumbai
PM2.5 concentrations (micro-g/cu.m.) in Indian cities
averaged over July to November - 2015



Comparison of Air Quality of Kolkata against most polluted 20 cities of the World

Let us discuss