

# **NATIONAL AMBIENT AIR QUALITY STATUS & TRENDS IN INDIA-2010**



**CENTRAL POLLUTION CONTROL BOARD  
MINISTRY OF ENVIRONMENT & FORESTS**

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**CPCB**

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(भारत सरकार का संगठन)

पर्यावरण एवं वन मंत्रालय

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### FOREWORD

Central Pollution Control Board (CPCB) has established the National Ambient Air Quality Monitoring (NAMP) Network, covering 209 cities/towns of the country in compliance with the mandate under the Air (Prevention and Control of Pollution) Act, 1981 to collect compile and disseminate information on air quality.

The ambient air quality is monitored collectively by Central Pollution Control Board (CPCB), State Pollution Control Boards (SPCBs), Pollution Control Committees (PCCs), and National Environmental Engineering Research Institute (NEERI). The data, thus generated, is transmitted to CPCB for scrutiny, analysis, compilation and its publication. The present Report contains ambient air quality data for the calendar year 2010 and trend analysis of major urban centres such as metropolitan cities since 2000. Air pollution status of various pollutants is described in terms of Low, Moderate, High and Critical category, vis-a-vis the notified ambient air standards. The status is depicted in the form of tables and figures as well.

The contributions made by my colleagues Dr. Sanjeev Agrawal, Scientist 'D', Sh. Tarun Darbari, Scientist 'B', Dr. Sanghita Roychoudhury, RA, Dr. Jitendra Kumar Nagar, RA and Ms. Razia Sultan, DEO, for compiling and presenting the data, under the supervision of Dr. D.D. Basu, Scientist 'E' and Sh. J.S. Kamyotra, Member Secretary is appreciable. Efforts made by CPCB Head Office / ZO's CPCB/SPCB's/PCC's and other collaborating agencies are acknowledged.

The co-operation of all the monitoring agencies is gratefully acknowledged in successfully achieving this major task. Hopefully, the report will be useful to all concerned.

Date : 12<sup>th</sup> March, 2012

(Mira Mehrishi)

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## ABBREVIATION

<b>Abbreviation</b>	<b>Meaning</b>
AD	Adequate data (locations where $\geq 50$ days of monitoring was done in a year)
As	Arsenic
B(a)P	Benzo (a) Pyrene
C	Critical pollution category
$C_6H_6$	Benzene
CO	Carbon monoxide
CPCB	Central Pollution Control Board
CPCB ZO	CPCB Zonal Offices
EDB	Environmental Data Bank
ES	Ecologically sensitive
ESA	Ecologically sensitive area
EF	Exceedence factor
H	High pollution category
$H_2S$	Hydrogen Sulphide
ID	Inadequate data (locations $< 50$ days of monitoring was done in a year)
L	Low pollution category
M	Moderate pollution category
NAAQS	National Ambient Air Quality Standards
NAMP	National Air Quality Monitoring Programme
ND	No data (Monitoring not done or data not received for the particular parameter)
NEERI	National Environmental Engineering Research Institute
$NH_3$	Ammonia
$NH_3$	Ammonia
Ni	Nickel
NM	No monitoring
$NO_2$	Nitrogen Dioxide
$O_3$	Ozone
PAHs	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCC	Pollution Control Committees
$PM_{10}$	Particulate matter of size $\leq 10\mu m$
$PM_{2.5}$	Particulate matter of size $\leq 2.5\mu m$
QA/QC	Quality assurance and Quality control
RSPM	Respiratory Suspended Particulate Matter
$SO_2$	Sulphur dioxide
SPCB	State Pollution Control Boards
SPM	Suspended Particulate Matter

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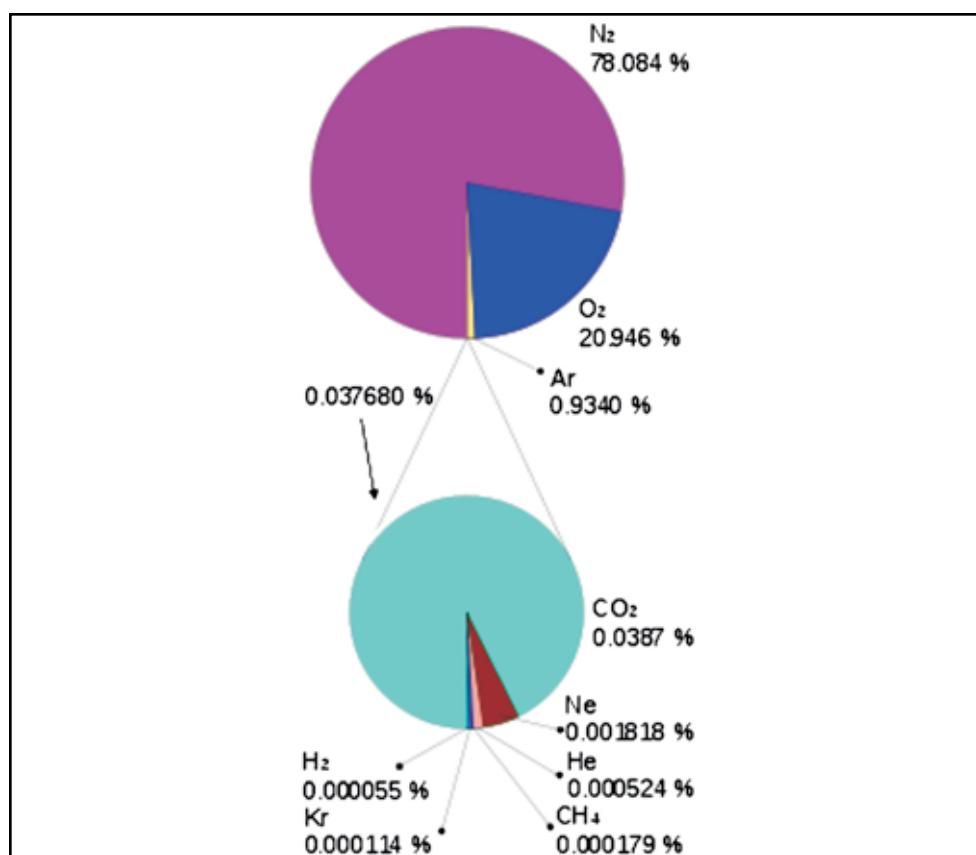
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The atmosphere of Earth is a layer of gases surrounding the planet Earth that is retained by Earth's gravity. Air is mainly composed of Nitrogen and Oxygen (99% by volume) and other gases including water vapor contribute to about 1%. (Figure I.I). Rapid urbanization and industrialization has added other elements/compounds to the pure air and thus caused the increase in pollution. In order to prevent, control and abate air pollution, the Air (Prevention and Control of Pollution) Act was enacted in 1981. According to Section 2(b) of Air (Prevention and control of pollution) Act, 1981 'air pollution' has been defined as 'the presence in the atmosphere of any air pollutant.' As per Section 2(a) of Air (Prevention and control of pollution) Act, 1981 'air pollutant' has been defined as 'any solid, liquid or gaseous substance [(including noise)] present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment'. Therefore ambient air quality standard is developed as a policy guideline that regulates the effect of human activity upon the environment so that pollutant emission into the air can be regulated. Standards may specify a desired state or limit alterations

**Figure I.I: Composition of air**



## I.I National Ambient Air Quality Standards (NAAQS)

The objectives of air quality standards are:

- To indicate the levels of air quality necessary with an adequate margin of safety to protect the public health, vegetation and property;
- To assist in establishing priorities for abatement and control of pollutant level;
- To provide uniform yardstick for assessing air quality at national level;
- To indicate the need and extent of monitoring programme.

The revised National Ambient Air Quality Standards notified on November 2009 is depicted below (Table I.I).

**Table I.I: Revised National Ambient Air Quality Standards (NAAQS)**[NAAQS Notification dated 18<sup>th</sup> November, 2009]

S. No.	Pollutants	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)	
1	Sulphur Dioxide (SO <sub>2</sub> ), $\mu\text{g}/\text{m}^3$	Annual*	50	20	1. Improved West and Gaeke 2. Ultraviolet Fluorescence
		24 Hours**	80	80	
2	Nitrogen Dioxide (NO <sub>2</sub> ), $\mu\text{g}/\text{m}^3$	Annual*	40	30	1. Modified Jacob & Hochheiser (Na-Arsenite) 2. Chemiluminescence
		24 Hours**	80	80	
3	Particulate Matter (Size <10 $\mu\text{m}$ ) or PM <sub>10</sub> , $\mu\text{g}/\text{m}^3$	Annual*	60	60	1. Gravimetric 2. TEOM 3. Beta attenuation
		24 Hours**	100	100	
4	Particulate Matter (Size <2.5 $\mu\text{m}$ ) or PM <sub>2.5</sub> , $\mu\text{g}/\text{m}^3$	Annual*	40	40	1. Gravimetric 2. TEOM 3. Beta attenuation
		24 Hours **	60	60	
5	Ozone (O <sub>3</sub> ), $\mu\text{g}/\text{m}^3$	8 hours**	100	100	1. UV photometric 2. Chemiluminescence 3. Chemical Method
		1 hours **	180	180	
6	Lead (Pb), $\mu\text{g}/\text{m}^3$	Annual *	0.50	0.50	1. AAS/ICP Method after sampling using EPM 2000 or equivalent filter paper 2. ED-XRF using Teflon filter
		24 Hour**	1.0	1.0	
7	Carbon Monoxide (CO), mg/m <sup>3</sup>	8 Hours **	02	02	Non dispersive Infra Red (NDIR) Spectroscopy
		1 Hour**	04	04	
8	Ammonia (NH <sub>3</sub> ), $\mu\text{g}/\text{m}^3$	Annual*	100	100	1. Chemiluminescence 2. Indophernol blue method
		24 Hour**	400	400	
9	Benzene (C <sub>6</sub> H <sub>6</sub> ), $\mu\text{g}/\text{m}^3$	Annual *	05	05	1. Gas chromatography based continuous analyzer 2. Adsorption and Desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP)- particulate phase only, ng/m <sup>3</sup>	Annual*	01	01	Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m <sup>3</sup>	Annual*	06	06	AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m <sup>3</sup>	Annual*	20	20	AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

\* Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform interval.

\*\* 24 hourly 08 hourly or 01 hourly monitored values, as applicable shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

**NOTE:** Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

## 1.2 Air Pollutants, their sources and effects

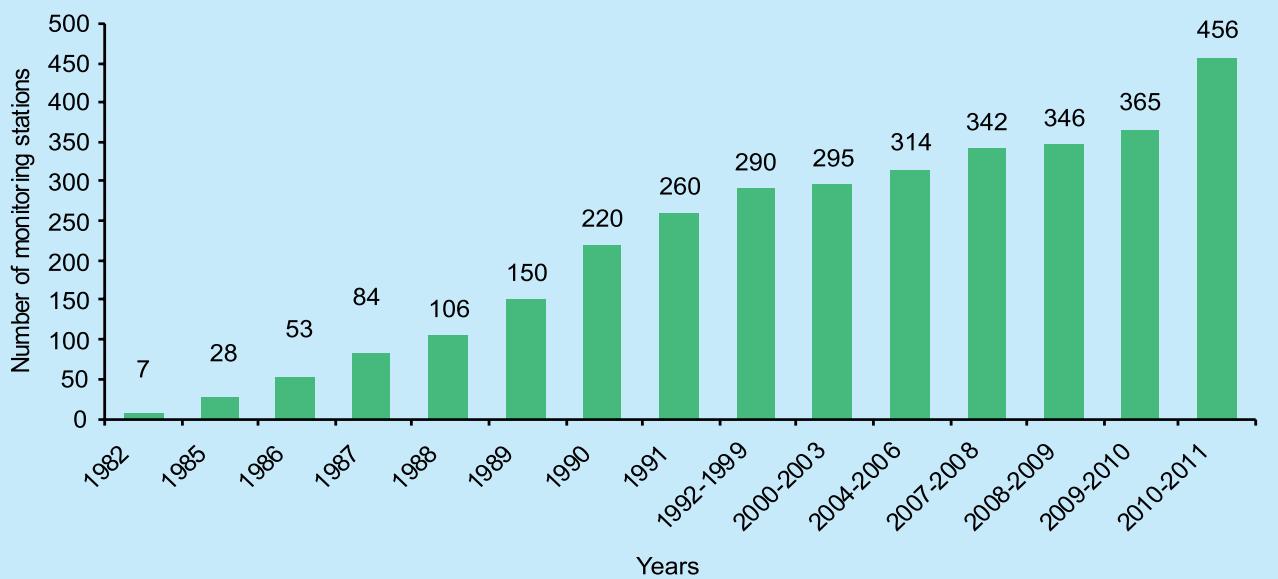
In order to combat air pollution it is required to identify the pollutants, its source of emission and investigate the effects of living and the environment. The Central Pollution Control Board has therefore identified and revised the National Ambient Air Quality Standards on April 11, 1994 which was notified in Gazette of India, Extra-ordinary Part-II Section 3, sub section (ii), dated May 20, 1994 (Table 1.1). The pollutants enlisted in the National Ambient Air Quality Standards and their sources and effects are summarized in Annexure I

## 1.3 National Air Quality Monitoring Programme (N.A.M.P.)

**1.3.1. Present status of NAMP :** Central Pollution Control Board initiated National Ambient Air Quality Monitoring (NAAQM) programme in the year 1984 with 7 stations at Agra and Anpara. Subsequently the programme was renamed as National Air Quality Monitoring Programme (NAMP).

Steadily the air quality monitoring network got strengthened by increasing the number of monitoring stations from 28 to 365 during 1985 – 2009. During the financial year 2010 – 11, 93 new stations were added and the number of stations under operation was raised to 456 covering 190 cities in 26 states and 5 Union Territories as on 31st March 2011. The growth in number of stations under operation is depicted in Figure 1.2. Figures 1.3 & 1.4 depict the status of operating against the sanctioned monitoring stations in different states and UTs respectively. As on 31<sup>st</sup> October 2011 the number of stations under operation has been further raised to 503 distributed in 209 cities, 26 states and 5 UTs.

**Figure 1.2: Growth in number of stations under operation in NAMP  
(As on 31st March 2011)**



**Table 1.2. Details of Air Quality Monitoring Stations under operation in India  
as on 31<sup>st</sup> March 2011**

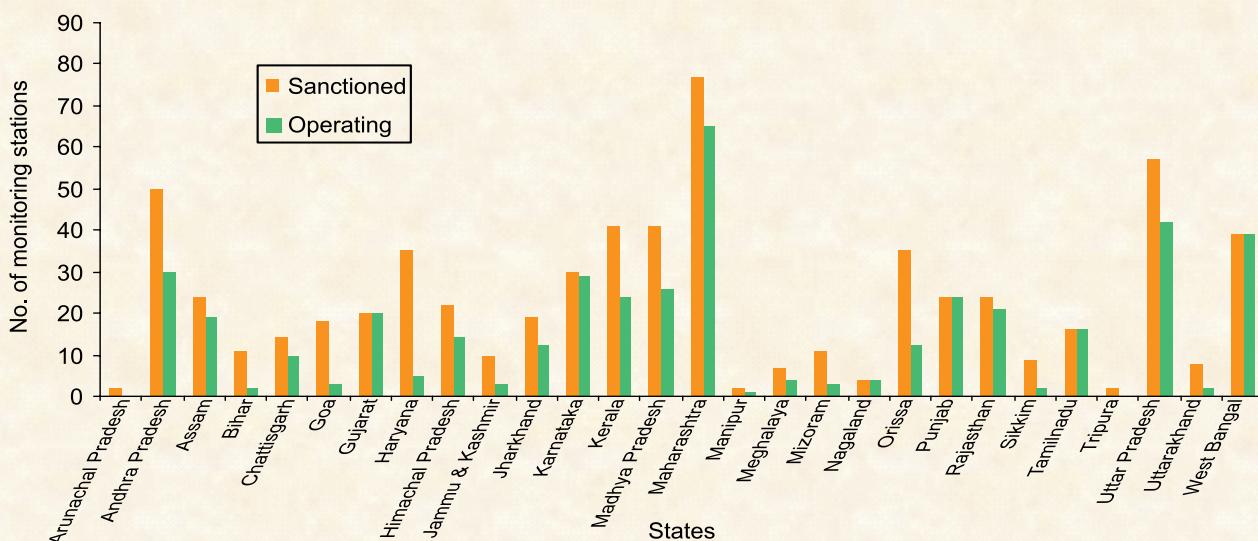
<b>S. No.</b>	<b>State/Union territory</b>	<b>City</b>	<b>Number of operating stations</b>
1	Andhra Pradesh (30)	Hyderabad	9
		Visakhapatnam	8
		Tirupati	1
		Vijayawada	2
		Kurnool	1
		Ramagundum	1
		Patencheru	1
		Nalgonda	1
		Guntur	1
		Warangal	1
		Nellore, Nellore	1
		Kakinada	1
		Khamam, Kothagudem	1
		Chitoor, Tirumala	1
2	Assam (19)	Bongaigaon	3
		Gawahati	4
		Tezpur	1
		Sivasagar	1
		Dibrugarh	1
		Golaghat	1
		Silcher	1
		Daranga	1
		Margheita	1
		North Lakhimpur	1
		Nagaon	1
		Tinsukhia	2
		Nalbari	1
3	Bihar (2)	Patna	2
4	Chandigarh (5)	Chandigarh	5
5	Chattisgarh (10)	Korba	3
		Bhilai	3
		Raipur	3
		Bilaspur	1
6	Delhi (9)	Delhi	9
7	Dadara & Nagar Haveli (2)	Silvassa	2
8	Daman Diu (2)	Daman	2
9	Goa (3)	Ponda	1
		Vasco	1
		Marmagao	1
10	Gujarat (20)	Ahmedabad	6
		Ankaleshwar	2
		Jamnagar	1
		Rajkot	2
		Surat	3
		Vadodara	4
		Vapi	2

S. No.	State/Union territory	City	Number of operating stations
11	Haryana (5)	Faridabad	2
		Hissar	2
		Yamuna Nagar	1
12	Himachal Pradesh (14)	Damtal	2
		Parwanoo	2
		Poanta Sahib	2
		Shimla	2
		Kala Amb	2
		Baddi-Barotiwala	3
		Nalagarh	1
13	Jammu& Kashmir (3)	Jammu	3
14	Jharkhand (12)	Dhanbad	1
		Jharia	3
		Sindri	1
		Jamshedpur	2
		Ranchi	1
		Hazaribagh	2
		Saraikela-Kharsawan	1
		West Singhbhum	1
15	Karnataka (29)	Bangalore	9
		Dharwar, Hubli	2
		Mangalore	1
		Hassan	1
		Mysore	2
		Gulbarga	1
		Belgaum	1
		Devanagere	2
		Mandy	1
		Raichur	1
		Bijapur	1
		Chitradurga	1
		Shimoga	1
		Karwar	1
		Ranebennur	1
		Bagalkote	1
		Kolar	1
		Bidar	1
16	Kerala (24)	Kozhikode	2
		Kottayam	2
		Cochin	7
		Thiruvananthapuram	4
		Palakkad	1
		Alappuzha	2
		Near District Office, KSPCB, Makkamkunnu, Pathanamthitta	1
		Kollam	2
		Sulthan, Bathery, Wayanad	1
		Kakkanchery, Near KINFRA, Mallappuram	1
		Kerala SPCB, District Office, Poonkunnam, Thrissur	1

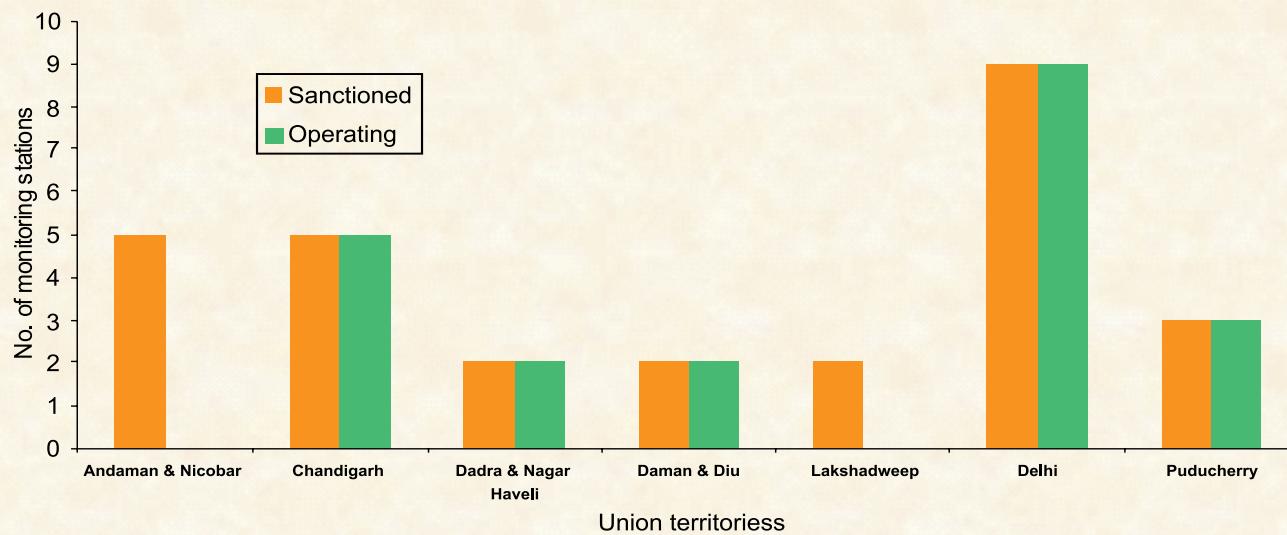
S. No.	State/Union territory	City	Number of operating stations
17	Madhya Pradesh (26)	Bhopal	4
		Indore	3
		Jabalpur	1
		Nagda	3
		Gwalior	2
		Sagar	2
		Satna	2
		Singrauli	3
		Ujjain	3
		Dewas	3
18	Maharashtra (65)	Aurangabad	3
		Lote	2
		Tarapur	3
		Kolhapur	3
		Mumbai	3
		Ambernath	2
		Chandrapur	6
		Nagpur	6
		Nasik	3
		Solapur	2
		Pune	3
		Thane	3
		Navi Mumbai (incl TTC Ind. Area, Taloja Ind Area)	6
		Mahad	3
		Roha	2
		Sangli	3
		Amravati	3
		Latur	3
		Ulhas Nagar	2
		Badlapur	1
		Jalgaon	3
19	Meghalaya (4)	Shillong	2
		Dwarki	1
		Ri-Bhoi, Brynihat	1
20	Mizoram (3)	Aizwal	3
21	Manipur (1)	Imphal	1
22	Nagaland (4)	Dimapur	2
		Kohima	2
23	Orissa (12)	Rayagada	2
		Rourkela	2
		Talcher	2
		Angul	2
		Bhubaneshwar	1
		Cuttack	1
		Sambalpur	1
		Berhampur	1

S. No.	State/Union territory	City	Number of operating stations
24	Punjab (24)	Gobindgarh	3
		Jalandhar	4
		Ludhiana	4
		Naya Nangal	2
		Khanna	2
		Pathankot(Dera baba)	1
		Amritsar	2
		Derra Bassi	2
		Bhatinda	1
		Batala	1
		Patiala	2
25	Pondicherry (3)	Pondicherry	3
26	Rajasthan (21)	Alwar	3
		Jaipur	6
		Jodhpur	6
		Kota	3
		Udaipur	3
27	Sikkim (2)	Gangtok	2
28	Tamilnadu (16)	Chennai	6
		Tuticorin	3
		Coimbatore	3
		Madurai	3
		Salem	1
29	Uttar Pradesh (42)	Agra	6
		Allahabad	2
		Anpara	2
		Firozabad	3
		Gajroula	2
		Ghaziabad	2
		Kanpur	6
		Lucknow	5
		Noida	2
		Varanasi	2
		Jhansi	2
		Khurja	2
		Meerut	2
		Bareily	2
		Moradabad	2
30	Uttarakhand (5)	Dehradun	3
		Haridwar	1
		Rishikesh	1
31	West Bengal (39)	Kolkata	10
		Durgapur	4
		Haldia	5
		Howrah	4
		Asansol	3
		Barrckpore	3
		Raniganj	3
		South Suburban	3
		Sankrail	4
<b>Total</b>	<b>26 states, 5UTs</b>	<b>190 cities</b>	<b>456 stations</b>

**Figure 1.3: Status of State wise Distribution of sanctioned versus operational air quality monitoring stations during 2010-2011**



**Figure 1.4: Status of Distribution of sanctioned versus operational air quality monitoring stations in Union Territories during 2010-2011**



### 1.3.2. Objectives of NAMP

The objectives of the NAMP are as follows:

- To determine status and trends of ambient air quality;
- To ascertain whether the prescribed ambient air quality standards are violated;
- To Identify Non-attainment Cities;
- To obtain the knowledge and understanding necessary for developing preventive and corrective measures;
- To understand the natural cleansing process undergoing in the environment through pollution dilution, dispersion, wind based movement, dry deposition, precipitation and chemical transformation of pollutants generated.

### 1.3.3. Parameters monitored under NAMP

Under NAMP three criteria pollutants viz.  $PM_{10}$  (Particulate Matter having an aerodynamic diameter less than or equal to  $10\ \mu m$ ), Sulphur dioxide ( $SO_2$ ) and Nitrogen dioxide ( $NO_2$ ) were identified for regular monitoring at all locations. Additional parameters like Carbon monoxide (CO), Ammonia ( $NH_3$ ), Lead (Pb) and Ozone ( $O_3$ ) are being monitored at selected locations. The other parameters as notified in revised NAAQS viz.  $PM_{2.5}$  (Particulate Matter having an aerodynamic diameter less than or equal to  $2.5\ \mu m$ ), Benzo(a)pyrene {B(a)P}, Arsenic (As) and (Ni) are slowly being added in monitoring network under NAMP.

The monitoring of meteorological parameters such as wind speed and direction, relative humidity and temperature were also integrated with the monitoring of air quality.

The monitoring of pollutants is carried out for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) with a frequency of twice a week, to have 104 observations in a year.

The monitoring under the NAMP is being carried out with the help of State Pollution Control Boards (SPCB), Pollution Control Committees (PCC) and National Environmental Engineering Research Institute (NEERI), Nagpur and Central Pollution Control Board (CPCB) head and Zonal Offices. CPCB co-ordinates with these agencies to ensure uniformity, consistency of air quality data and provides technical and financial support to them for operating the monitoring station (Plate I.I.).

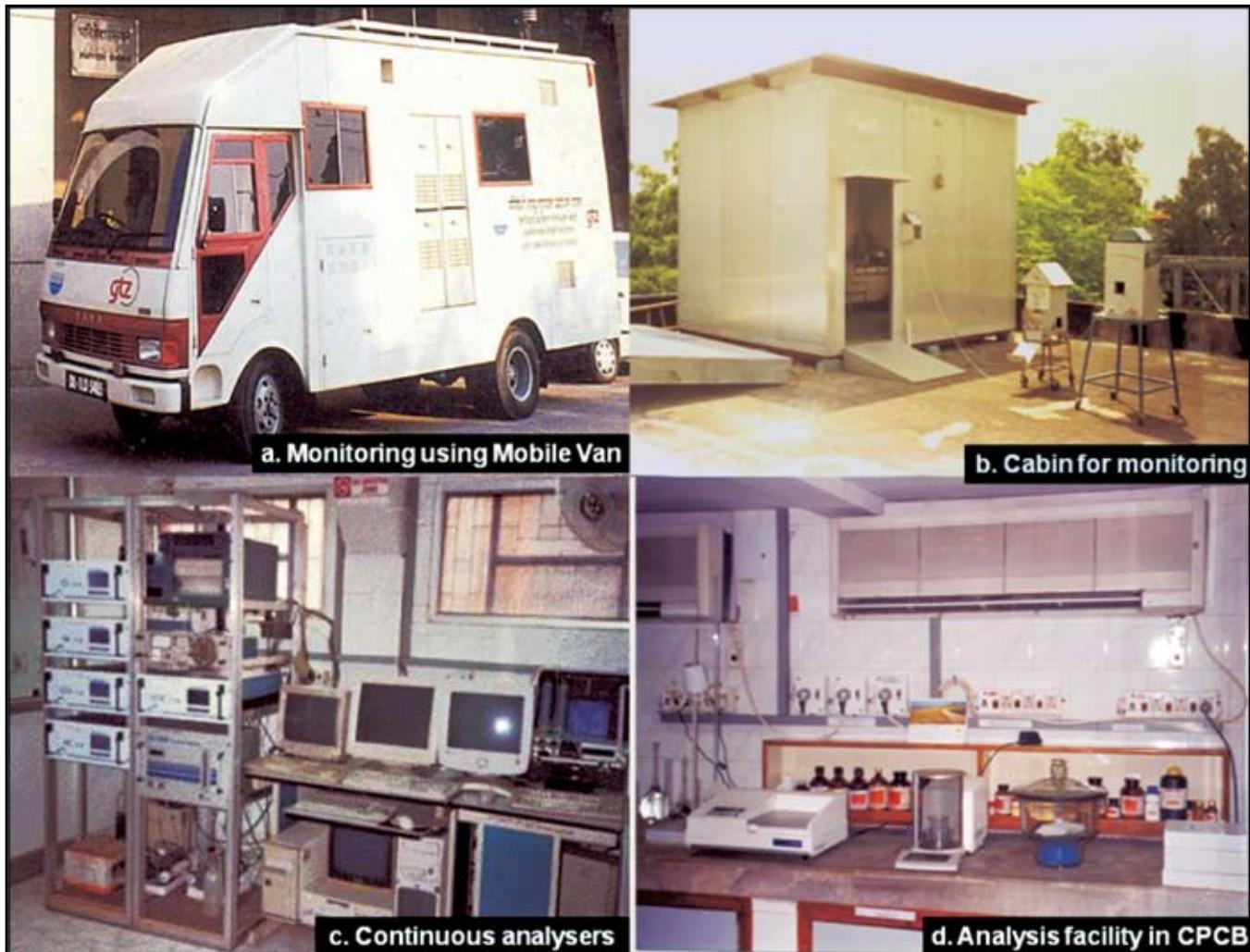


Plate I.I. Different monitoring modes a. Mobile van monitoring, b. cabin for monitoring, c. Continuous analysers and d. analysis facility under NAMP

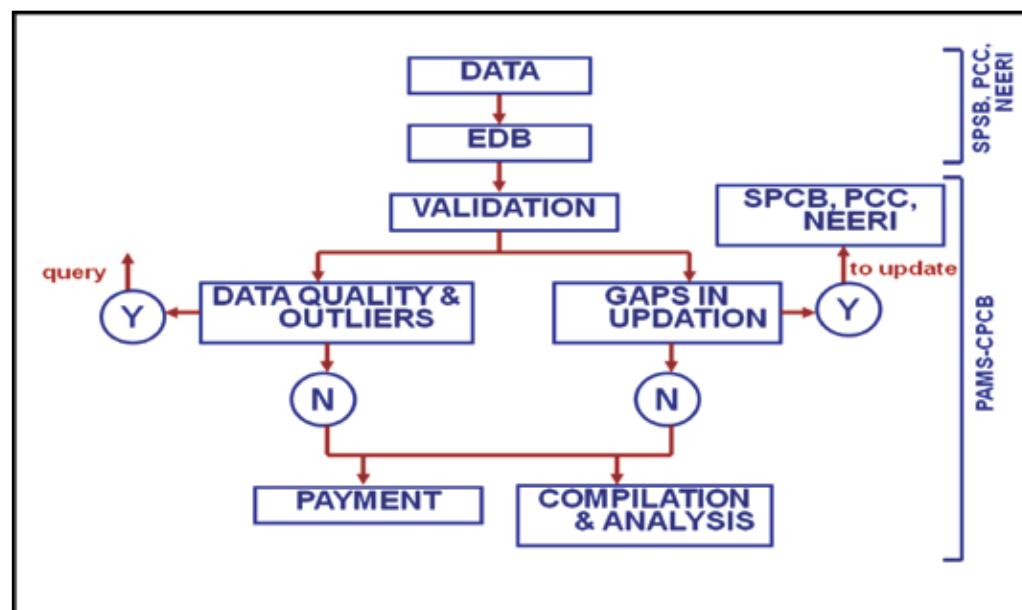
### 1.3.4. Data Analysis and Limitations

The air quality data generated at the monitoring stations are entered into Environmental Data Bank (EDB) by respective SPCBs and PCCs and transmitted to CPCB where the data is scrutinized for outliers and gaps in input of data. In case of any gaps the matter is discussed with the respective agencies and later the data is checked, scrutinized, compiled, processed and analyzed statistically to get the information on the annual mean, standard deviation etc. of the pollutants and payment is also made to the respective agencies. Figure 1.5 shows the data flow in NAMP. In the present report, results of PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>2</sub> for the year 2010 are presented.

While presenting the air quality data in this report following conventions have been followed:

- i. If the 24 hours sampling in a day could not be fulfilled at all the locations due to force majeure like power failure, rainfall etc, and the values monitored for 16 hours and more are considered as the representative values for assessing the ambient air quality for that day;
- ii. In case no data is available in a particular month with respect to all the three parameters, the month has been excluded;
- iii. In case, no data is reported for a particular station with respect to all the three parameters, during entire year, that station has been excluded; and
- iv. The frequency of monitoring twice a week, 104 days in a year could not be met in some of the locations. In such cases, 50 days of monitoring in a year is considered adequate for the purpose of data analysis.

**Figure 1.5 Data flow chart under NAMP**



As NAMP is being operated through various monitoring agencies, a large number of personnel and equipments are involved in the sampling, chemical analyses, data reporting etc.. This increases the probability of personal biases reflecting in the data. Hence it is pertinent to mention that this document be referred keeping in view the above facts and the data be considered more as indicative rather than absolute. The data presented in this report is average over the entire year as available.

### 1.3.5. Quality Assurance/Quality Control of Data and Management

Quality assurance and Quality control (QA/QC) is an essential part of any monitoring system. QA/QC is a programme of activities that ensures that measurements meet defined standards of quality, with a stated level of confidence. In order to ensure the quality of data the CPCB is carrying out various exercises as follows:

- i) **Calibration, Servicing and Repair of Instruments** CPCB is carrying out a project on calibration, servicing and repair of instruments/equipments and evaluation of ambient air quality monitoring stations under NAMP. Servicing and repair of respirable dust sampler and high volume sampler is carried out and they are also calibrated using top loading calibrator (Plate I.2). The location of monitoring stations is evaluated as per CPCB guidelines so as to ensure quality of data.
- ii) **Training Program on Ambient Air Quality Monitoring** CPCB carries out training program on ambient air quality monitoring with an objective to improve quality of data generated under National Air Quality Monitoring Programme (NAMP). Training is provided to field and laboratory staff involved in NAMP. The training is provided on measurement methods of air pollutants i.e. sulphur dioxide ( $\text{SO}_2$ ), nitrogen dioxide ( $\text{NO}_2$ ), particulate matter of size less than  $10\mu\text{g}$  ( $\text{PM}_{10}$ ) and suspended particulate matter (SPM) etc.
- iii) **Guidelines for Ambient Air Quality Monitoring** CPCB has developed guidelines for carrying out ambient air quality monitoring. The Guidelines for Ambient Air Quality Monitoring include site selection criteria, quality assurance and quality control in air quality monitoring, type of pollutants to be monitored in a city, frequency and duration of monitoring, data reporting and compilation procedures and measurement methods of various air pollutants etc.
- iv) **Evaluation of Ambient Air Quality Monitoring Stations** Regular Inspection of Monitoring stations and monitoring laboratories are regularly inspected by CPCB officials to ensure proper and uniform methodology for sampling and analysis.
- v) **Review meetings of NAMP** are regularly conducted with monitoring agencies to discuss various problems related to monitoring activities and sort out the remedial measures.
- vi) **Analytical quality control exercises** using Ring Test Facility are regularly conducted to evaluate the performance of different laboratories.

**NB.** In this report data has been taken from 1<sup>st</sup> January 2010 to 31<sup>st</sup> December 2010. Operating stations has been listed as numbers reported till 31<sup>st</sup> March 2010 (financial year wise). However, there are cases where data has been given on October 2010 which has been included during data analysis.



Plate I.2. Field calibration a, b. Top loading calibration of Respirable Dust Sampler at Kurnool and Goa c. Use of dry gas meter for gaseous calibration at Vizag d. Calibration of balance at Ramachandrapuram

Air Quality Assessment and major findings of the ambient air quality monitoring carried out countrywide during the year 2010 are presented in this chapter. The air quality of different cities/towns has been compared with the respective NAAQS.

## 2.1 Air Quality Assessment

The air quality of different cities/towns has been compared with the respective NAAQS. The air quality has been categorized into four broad categories based on an Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard). The Exceedence Factor (EF) is calculated as follows:

$$\text{Exceedence Factor} = \frac{\text{Observed annual mean concentration of criteria pollutant}}{\text{Annual standard for the respective pollutant and area class}}$$

The four air quality categories are:

- Critical pollution (C) : when EF is  $> 1.5$ ;
- High pollution (H) : when the EF is between  $1.0 - < 1.5$ ;
- Moderate pollution (M) : when the EF between  $0.5 - < 1.0$ ; and
- Low pollution (L): when the EF is  $< 0.5$ .

It is obvious from the above categorization, that the locations in either of the first two categories are actually not meeting the standards, although, with varying magnitude. Those, falling in the third category are meeting the standards as of now but likely to exceed the standards in future if pollution continues to increase and is not controlled. However, the locations in Low pollution category have a rather clean air quality and such areas are to be maintained at low pollution level by way of adopting preventive and control measures of air pollution. The pollution control classification is given in Table 2.1.

**Table 2.1: Pollution Level Classification**

Pollution level	Annual Mean Concentration Range ( $\mu\text{g}/\text{m}^3$ )					
	Industrial, Residential,Rural & others areas			Ecologically Sensitive Area		
	$\text{SO}_2$	$\text{NO}_2$	$\text{PM}_{10}$	$\text{SO}_2$	$\text{NO}_2$	$\text{PM}_{10}$
<b>Low (L)</b>	0-25	0-20	0-30	0-10	0-15	0-30
<b>Moderate (M)</b>	26-50	21-40	31-60	11-20	16-30	31-60
<b>High (H)</b>	51-75	41-60	61-90	21-30	31-45	61-90
<b>Critical (C)</b>	$>75$	$>60$	$>90$	$>30$	$>45$	$>90$

This report represent the air quality scenario with air quality data from January – December 2010 of **402 stations from residential / commercial / industrial / rural area** and **31 stations from ecologically sensitive area** {Notified by Ministry of Environment and Forests under Section 3(2)(V) of Environment (Protection) Act, 1986 and Rule 5(3)(d) of Environment (Protection) Rules, 1986} ie a **total of 433 stations**. Adequate data on annual average concentration (with 50 and more day of monitoring) was received from 360 stations for  $\text{SO}_2$ , 362 stations for  $\text{NO}_2$  and 359 stations  $\text{PM}_{10}$  for residential / commercial / industrial / rural area. The total number of stations considered for  $\text{NO}_2$  and  $\text{PM}_{10}$  were 402 and  $\text{SO}_2$  was 401 as the data for Byrnihat, Meghalaya in case of  $\text{SO}_2$  was outlier. Therefore, it was not considered. In case of Ecologically Sensitive Area adequate data was received from 25 stations for  $\text{SO}_2$ , 24 stations for  $\text{NO}_2$  and 26 stations for  $\text{PM}_{10}$ . The total number of stations considered were 31 for each parameter. The detail of number of stations for which data was adequate or inadequate is given in Table 2.2.

**Table 2.2: Details of data generated during 2010**

Data type	Number of monitoring stations					
	Residential / industrial / rural / commercial areas			Ecologically sensitive area		
	SO <sub>2</sub>	NO <sub>2</sub>	PM <sub>10</sub>	SO <sub>2</sub>	NO <sub>2</sub>	PM <sub>10</sub>
Adequate data	360	362	359	25	24	26
Inadequate data	38	37	42	4	5	5
No data	3	3	1	2	2	0
<b>Total monitoring stations</b>	<b>401</b>	<b>402</b>	<b>402</b>	<b>31</b>	<b>31</b>	<b>31</b>

Key: Adequate data: locations where  $\geq 50$  days of monitoring was done in a year; Inadequate data: locations  $< 50$  days of monitoring was done in a year; No data: Monitoring not done or data not received for the particular parameter

## 2.2 Number of locations / monitoring stations with low, moderate, high and critical pollution level of air pollution

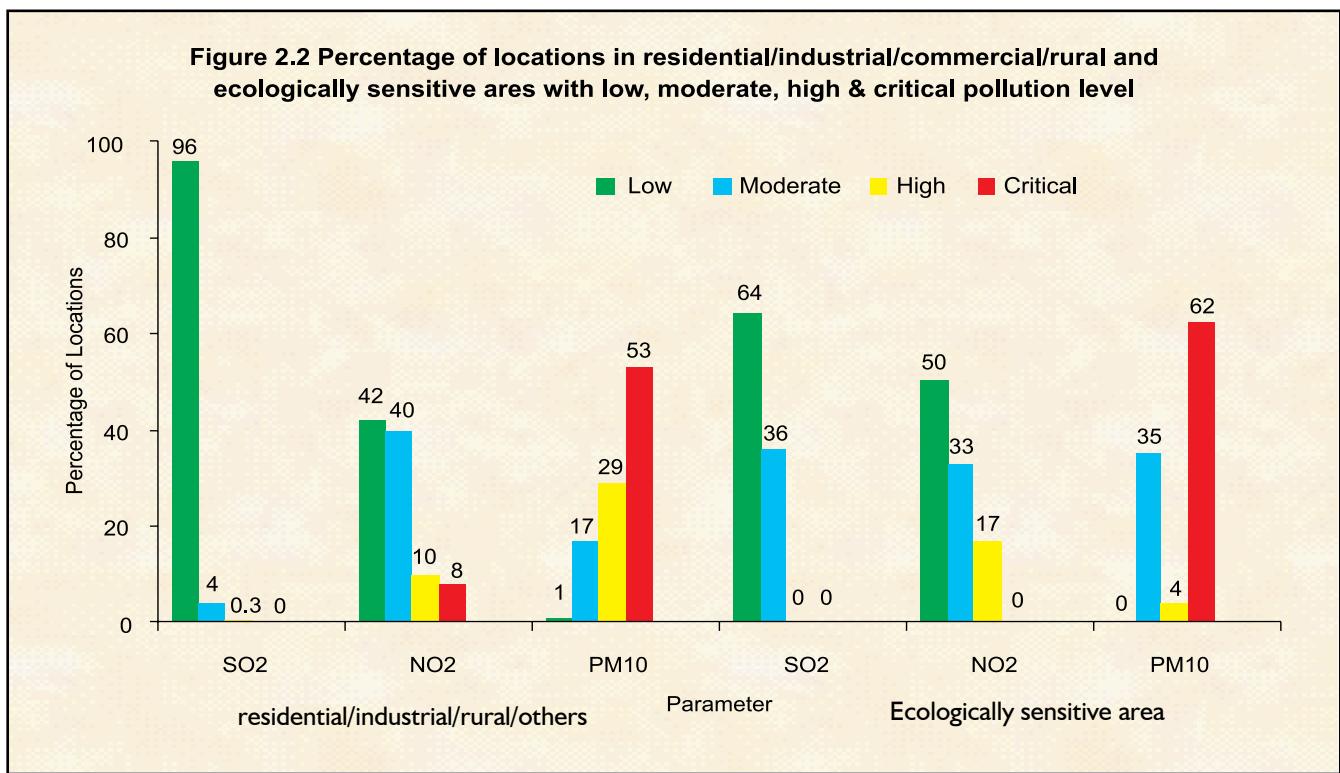
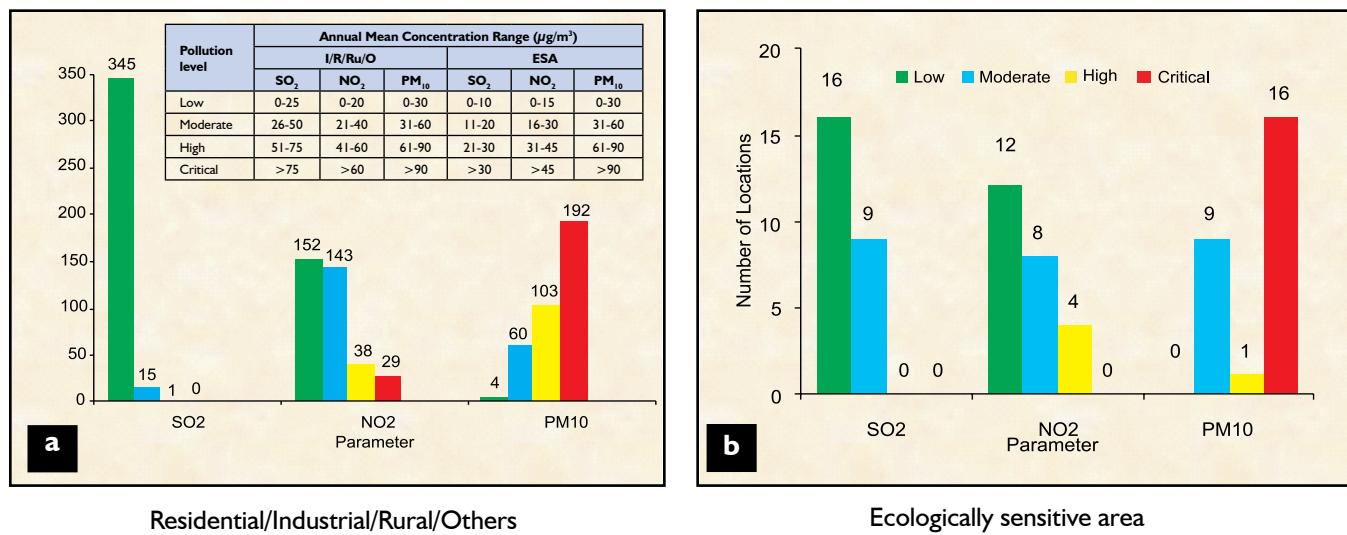
The analysis of three criteria pollutants (adequate data) with respect to National Ambient Air Quality Standards (NAAQS) during 2010 revealed that SO<sub>2</sub> showed low concentration in most of the locations (345 locations, 96%), moderate in 15 locations (4%) and high in 1 location. With respect to NO<sub>2</sub>, 152 locations (42%) were in low category, 143 in moderate (40%), 38 in high (10%) and 29 (8%) in critical category. With respect to PM<sub>10</sub>, only 4 locations (1%) showed low PM<sub>10</sub> level, 60 locations (17%) showed moderate, 103 high (29%) and 192 location (53%) were in critical category. Table 2.3, Figure 2.1a shows categorization of locations according to low, moderate, high and critical level of pollutants in residential / industrial / commercial / rural and other Figure 2.1b shows the same in ecologically sensitive areas. Locations at sensitive zones also showed more or less a similar trend. SO<sub>2</sub> mainly showed low concentration in most of the locations (16 locations, 64%) and moderate in 9 locations (36%). There was no cities in high or critical range. With respect to NO<sub>2</sub>, 12 locations (50%) were in low category, 8 in moderate (33%) and 4 in high (17%). In case of PM<sub>10</sub> no location showed low PM<sub>10</sub> level. 9 (35%) locations showed moderate and 1 (4%) high and 16 (62%) locations were in critical category. Table 2.3, Figure 2.2 gives a picture of percentage of locations according to low, moderate, high and critical level of pollutants in both residential / industrial / commercial / rural and other and sensitive areas.

**Table 2.3: Number of locations with low, moderate, high & critical air quality (residential/industrial/commercial/rural and sensitive)**

Category	Number of monitoring stations					
	Residential / industrial / rural / commercial areas			Ecologically sensitive area		
	SO <sub>2</sub>	NO <sub>2</sub>	PM <sub>10</sub>	SO <sub>2</sub>	NO <sub>2</sub>	PM <sub>10</sub>
Low (L)	345 (96)	152 (42)	4 (1)	16 (64)	12 (50)	0 (0)
Moderate (M)	15 (4)	143 (40)	60 (17)	9 (36)	8 (33)	9 (35)
High (H)	1 (0.3)	38 (10)	103 (29)	0 (0)	4 (17)	1 (4)
Critical (C)	0 (0)	29 (8)	192 (53)	0 (0)	0 (0)	16 (62)
Inadequate data (ID)	38	37	42	4	5	5
No monitoring (NM)	3	3	1	2	2	0
<b>Total locations (LMHC)</b>	<b>361</b>	<b>362</b>	<b>359</b>	<b>25</b>	<b>24</b>	<b>26</b>
<b>Grand total (L/M/H/C/IA/NM)</b>	<b>401</b>	<b>402</b>	<b>402</b>	<b>31</b>	<b>31</b>	<b>31</b>

**NB.** Low, moderate, high, critical classification based on Pollution Level Classification, Chapter 2, Table 2. Figures in parenthesis represent percentage of stations in a particular category.

**Figure 2.1 a,b: a.Number of locations with low, moderate, high & critical pollution level in  
a. residential/industrial/commercial/rural b. ecologically sensitive areas**



### 2.3 Number of cities with low, moderate, high and critical pollution levels in the country

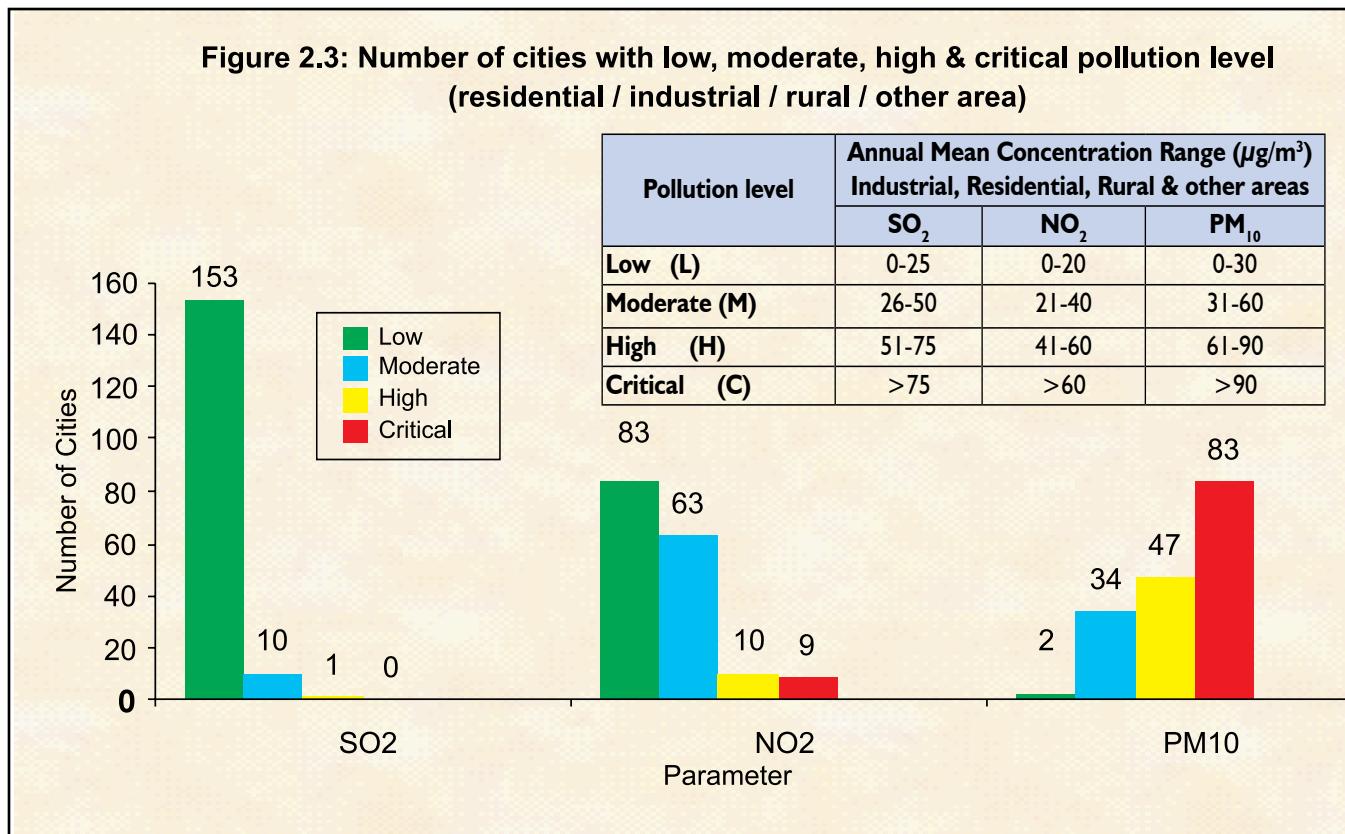
The analysis of three pollutants was done in 167 (SO<sub>2</sub>) and 168 (NO<sub>2</sub> and PM<sub>10</sub>) cities of residential / industrial / commercial / rural and other areas. In case of ecologically sensitive area analysis of three pollutants was done in 13 cities for the three parameters. Data with number of monitoring days less than 50 has also been considered with respect to all the parameters. Data for 2010 for residential / industrial / commercial / rural and other areas revealed that 153 cities fall under low category and 10 under moderate category I (Lote in Maharashtra) under high category with respect to Sulphur dioxide (SO<sub>2</sub>). NO<sub>2</sub> pollution levels if considered time weighted annual average

concentrations indicated that 83 cities are under the low category, 63 under moderate, 10 under high and 9 cities in the critical category.  $\text{PM}_{10}$  indicated that 2 cities fall under low category, 35 cities in moderate category, 47 cities in high pollution levels category and 83 cities in critical category. The number of cities with low, moderate, high and critical categories are depicted in Table 2.4, Figure 2.3. Figure 2.4 shows the percentage of cities in low, moderate, high and critical categories

**Table 2.4: Number of cities with low, moderate, high & critical air quality**

Category	Number of cities					
	Cities with Residential/industrial/ rural/commercial areas			Cities with sensitive area		
	$\text{SO}_2$	$\text{NO}_2$	$\text{PM}_{10}$	$\text{SO}_2$	$\text{NO}_2$	$\text{PM}_{10}$
Low	153 (93)	83 (50)	2 (1)	9 (75)	6 (50)	0
Moderate	10 (6)	63 (38)	35 (21)	2 (17)	5 (42)	3 (23)
High	1 (1)	10 (6)	47 (28)	1 (8)	1 (8)	3 (23)
Critical	0	9 (5)	83 (50)	0	0	7 (54)
No monitoring	3	3	1	1	1	0
Total cities (LMHC)	164	165	167	12	12	13
Grand total (L/M/H/C/NM)	167	168	168	13	13	13

**NB.** Low, moderate, high, critical classification based on Pollution Level Classification, Chapter 2, Table 2. I Figures within parenthesis represent percentage



**Figure 2.4: Percentage of cities showing low, moderate, high and critical level of SO<sub>2</sub>, NO<sub>2</sub> and PM<sub>10</sub> (residential / industrial / rural / other area)**

Figure 2.4a: Percentage of cities showing low, moderate, high and critical level of SO<sub>2</sub>

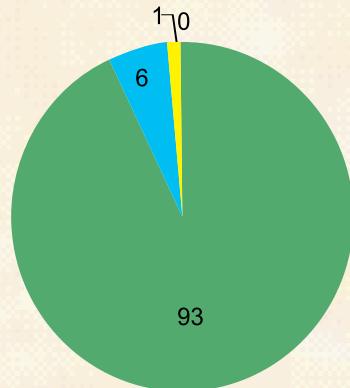
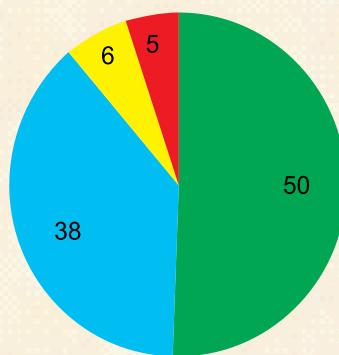
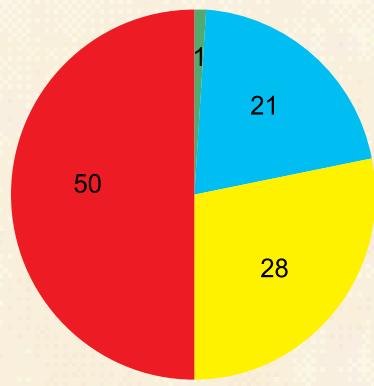


Figure 2.4b : Percentage of cities showing low, moderate, high and critical level of NO<sub>2</sub>



█ Low  
█ Moderate  
█ High  
█ Critical

Figure 2.4c: Percentage of cities showing low, moderate, high and critical level PM<sub>10</sub>



Pollution level	Annual Mean Concentration Range ( $\mu\text{g}/\text{m}^3$ ) Industrial, Residential, Rural & other areas		
	SO <sub>2</sub>	NO <sub>2</sub>	RSPM
Low (L)	0-25	0-20	0-30
Moderate (M)	26-50	21-40	31-60
High (H)	51-75	41-60	61-90
Critical (C)	>75	>60	>90

Annual average in each city and its categorization for different pollutant is represented in Table 2.5 represent the. Close examination of Table 2.5 indicates that:

- Cities like Badlapur and Ulhasnagar (Maharashtra), Asansol, Durgapur, Barrackpur, Howrah, Kolkata Raniganj and Sankrail (West Bengal) are critical with respect to both NO<sub>2</sub> and PM<sub>10</sub>
- State capital cities like Patna, Raipur, Delhi Ahmedabad, Ranchi, Bhopal, Mumbai, Amritsar, Jaipur, Lucknow, and Kolkata are critical with respect to PM<sub>10</sub>
- Industrial cities like Bhilai, Korba, Ahmedabad, Faridabad, Jamshedpur, Jharia, Sindri, Ludhiana, Muradabad, Rourkela, Indore, Kota, Kanpur, Asansol, Durgapur, Howrah are critical with respect to PM<sub>10</sub>

**Table 2.5: a. Ambient Air Quality in different cities for the year 2010**  
 (residential / industrial / rural / others & ecologically sensitive areas)

State	City	Type of station	Category of ESA	SO <sub>2</sub>		NO <sub>2</sub>		PM <sub>10</sub>	
				Annual average (µg/m <sup>3</sup> )	Air quality	Annual average (µg/m <sup>3</sup> )	Air quality	Annual average (µg/m <sup>3</sup> )	Air quality
Andhra Pradesh	Chittoor	RIRuO		4	L	9	L	39	M
	Guntur	RIRuO		2	L	11	L	81*	H
	Hyderabad	RIRuO		5	L	24	M	79*	H
	Kothagudem	RIRuO		2	L	11	L	62*	H
	Kurnool	RIRuO		4	L	9	L	85*	H
	Nalgonda	RIRuO		5	L	23	M	85*	H
	Nellore	RIRuO		2	L	12	L	65*	H
	Patencheru	RIRuO		11	L	23	M	76*	H
	Ramagundam	RIRuO		4	L	12	L	68*	H
	Tirupati	RIRuO		4	L	9	L	37	M
	Vijaywada	RIRuO		6	L	14	L	93*	C
	Warangal	RIRuO		4	L	10	L	52	M
Assam	Vishakhapatnam	RIRuO		7	L	16	L	71*	H
	Bongaigaon	RIRuO		6	L	15	L	58	M
	Daranga	RIRuO		5	L	14	L	58	M
	Dibrugarh	RIRuO		6	L	14	L	38	M
	Golaghat	ES	Numaligarh	6	L	15	L	73*	C
	Guwahati	RIRuO		7	L	15	L	94*	C
	Lakhimpur	RIRuO		6	L	15	L	76*	H
	Nagaon	RIRuO		6	L	14	L	103*	C
	Nalbari	RIRuO		7	L	16	L	68*	H
	Sibsagar	RIRuO		6	L	14	L	59	M
	Silchar	RIRuO		6	L	16	L	81*	H
	Tezpur	RIRuO		6	L	13	L	68*	H
Bihar	Tinsukia	RIRuO		7	L	16	L	58	M
	Patna	RIRuO		7	L	40	M	181*	C
Chandigarh	Chandigarh	RIRuO		2	L	16	L	92*	C
Chattisgarh	Bhillai	RIRuO		9	L	22	M	109*	C
	Bilaspur	RIRuO		8	-	19	-	-	-
	Korba	RIRuO		13	L	21	M	104*	C
	Raipur	RIRuO		15	-	43*	-	289*	C
Dadra & Nagar Haveli	Silvassa	RIRuO		7	L	18	L	39	M

State	City	Type of station	Category of ESA	SO <sub>2</sub>		NO <sub>2</sub>		PM <sub>10</sub>	
				Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality
Daman & Diu	Daman	RIRuO		7	L	18	L	35	M
Delhi	Delhi	RIRuO		5	L	55*	H	261*	C
Goa	Panaji	RIRuO		4	L	17	L	85*	H
	Marmagao	RIRuO		32	M	18	L	59	M
	Vasco	RIRuO		6	L	19	L	61*	H
	Curchorem	RIRuO		32	-	17	-	38	-
	Codlii	RIRuO		10	-	27	-	90*	-
	Bicholim	RIRuO		9	-	50*	-	89*	-
	Amona	RIRuO		6	-	18	-	55	-
	Assanora	RIRuO		5	-	16	-	71*	-
	Honda	ES	Sahyadri	8	L	25	M	100*	C
	Usgao	RIRuO		6	-	10	-	245*	-
Gujarat	Ahmedabad	RIRuO		15	L	21	M	95*	C
	Anklesvar	RIRuO		16	L	24	M	77*	H
	Jamnagar	RIRuO		12	L	27	M	104*	C
	Rajkot	RIRuO		13	L	17	L	96*	C
	Surat	RIRuO		16	L	24	M	76*	H
	Vadodara	RIRuO		17	L	29	M	93*	C
	Vapi	RIRuO		16	L	24	M	80*	H
Haryana	Faridabad	RIRuO		18	L	29	M	164*	C
	Hissar	RIRuO		8	-	8	-	95*	-
	Yamunanagar	RIRuO		12	L	26	M	261	C*
Himachal Pradesh	Baddi	RIRuO		3	L	16	L	105*	C
	Damtal	RIRuO		2	L	11	L	68*	H
	Kala Amb	RIRuO		3	L	18	L	79*	H
	Nalagarh	RIRuO		3	L	18	L	86*	H
	Parwanoo	RIRuO		3	L	12	L	84*	H
	Paonta Sahib	RIRuO		3	L	17	L	135*	C
	Shimla	ES	Hill station	3	L	13	L	58	M
Jammu & Kashmir	Jammu	RIRuO		7	L	15	L	115*	C

State	City	Type of station	Category of ESA	SO <sub>2</sub>		NO <sub>2</sub>		PM <sub>10</sub>	
				Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality
Jharkhand	Dhanbad	RIRuO		15	L	36	M	184*	C
	Jamshedpur	RIRuO		35	M	48*	H	153*	C
	Jharia	RIRuO		17	L	38	M	237*	C
	Ranchi	RIRuO		19	L	35	M	172*	C
	Saraikela Khar-sawan	RIRuO		35	M	45*	H	169*	C
	Sindri	RIRuO		16	-	37	-	174*	-
	West Singhbhum	RIRuO		21	L	32	M	302*	C
Karnataka	Bangalore	RIRuO		14	L	31	M	89*	H
	Belgaum	ES	Sahyadri	2	L	15	L	33	M
	Gulburga	RIRuO		9	L	13	L	65*	H
	Hassan	RIRuO		5	L	22	M	45	M
	Hubli-Dharwad	RIRuO		5	L	13	L	92*	C
	Mangalore	RIRuO		6	L	8	L	48	M
	Mysore	RIRuO		10	L	28	M	44	M
Kerala	Alappuzha	RIRuO		2	L	5	L	44	M
	Kochi	RIRuO		4	L	17	L	61*	H
	Kollam	RIRuO		3	L	15	L	47	M
	Kottayam	RIRuO		6	L	19	L	47	M
	Kozhikode	RIRuO		2	L	9	L	42	M
	Malapuram	RIRuO		2	L	5	L	30	L
	Palakkad	RIRuO		3	L	6	L	32	M
	Pathanamthitta	RIRuO		2	L	13	L	27	L
	Thissur	RIRuO		2	L	7	L	31	M
	Wayanad	RIRuO		2	L	12	L	46	M
	Trivandrum	RIRuO		9	L	24	M	56	M
	Bhopal	RIRuO		9	L	18	L	133*	C
Madhya Pradesh	Dewas	RIRuO		12	L	18	L	85*	H
	Gwalior	RIRuO		12	L	20	L	308*	C
	Indore	RIRuO		14	L	18	L	120*	C
	Jabalpur	RIRuO		2	-	25	-	135*	-
	Nagda	RIRuO		19	L	24	M	95*	C
	Sagar	RIRuO		4	L	17	L	66*	-
	Satna	RIRuO		3	L	6	L	194*	C
	Singrauli	RIRuO		15	-	19	-	59	-
	Ujjain	RIRuO		12	L	13	L	80*	H

State	City	Type of station	Category of ESA	SO <sub>2</sub>		NO <sub>2</sub>		PM <sub>10</sub>	
				Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality
Maharashtra	Amravati	RIRuO		12	L	14	L	118*	C
	Aurangabad	RIRuO		6	L	21	M	75*	H
	Badlapur	RIRuO		32	M	73*	C	112*	C
	Chandrapur	RIRuO		26	M	26	M	152*	C
	Jalgaon	RIRuO		17	L	45*	H	122*	C
	Kolhapur	ES	Sahyadri	15	M	22	M	83*	H
	Latur	RIRuO		8	L	16	L	106*	C
	Lote	RIRuO		60*	-	30	-	119*	-
	Pune	RIRuO		29	M	39	M	82*	H
	Mahad	RIRuO		19	L	38	M	93*	C
	Mumbai	RIRuO		4	L	19	L	97*	C
	Nagpur	RIRuO		7	L	33	M	113*	C
	Nashik	RIRuO		21	L	26	M	76*	H
	Navi Mumbai	RIRuO		20	L	39	M	113*	C
	Roha	RIRuO		16	L	34	M	89*	H
	Sangli	RIRuO		14	L	27	M	62*	H
	Solapur	RIRuO		17	L	35	M	66*	H
	Thane	RIRuO		14	L	14	L	50	M
	Ulhasnagar	RIRuO		31	M	68*	C	106*	C
Meghalaya	Byrnihat	RIRuO		-	-	15	L	175*	C
	Dawki	RIRuO		2	L	6	L	71*	H
	Shillong	ES	Hill station	2	L	10	L	79*	H
	Tura	RIRuO		2	-	9	-	63*	-
Mizoram	Aizawl	Hill station		2	L	6	L	42	M
Nagaland	Dimapur	RIRuO		2	L	7	L	76*	H
Nagaland	Kohima	ES	Hill station	2	L	5	L	66*	H
Orissa	Angul	RIRuO		7	L	21	M	110*	C
	Balasore	RIRuO		2	L	12	L	73*	H
	Berhampur	RIRuO		2	L	13	L	58	M
	Bhubneshwar	RIRuO		2	L	18	L	84*	H
	Cuttack	RIRuO		2	L	21	M	74*	H
	Rayagada	RIRuO		2	L	20	L	58	M
	Rourkela	RIRuO		5	L	11	L	105*	C
	Sambalpur	RIRuO		3	L	15	L	50	M
	Talcher	RIRuO		12	L	23	M	116*	C

State	City	Type of station	Category of ESA	SO <sub>2</sub>		NO <sub>2</sub>		PM <sub>10</sub>	
				Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality
Punjab	Amritsar	RIRuO		14	L	36	M	219*	C
	Bhatinda	RIRuO		9	L	21	M	216*	C
	Dera Bassi	RIRuO		10	L	23	M	162*	C
	Pathankot/Dera Baba	RIRuO		7	L	14	L	76*	H
	Gobindgarh	RIRuO		18	L	35	M	224*	C
	Jalandar	RIRuO		11	-	29	-	144*	-
	Khanna	RIRuO		9	L	31	M	231*	C
	Ludhiana	RIRuO		9	L	32	M	214*	C
	Naya Nangal	RIRuO		7	L	16	L	94*	C
	Patiala	RIRuO		7	L	20	L	143*	C
Puducherry	Puducherry	RIRuO		6	L	13	L	38	M
Rajasthan	Alwar	ES	Aravali range	8	L	24	M	225*	C
	Jaipur	RIRuO		6	L	37	M	164*	C
	Jodhpur	RIRuO		6	L	22	M	181*	C
	Kota	RIRuO		10	L	29	M	132*	C
	Udaipur	RIRuO		6	L	34	M	116*	C
Tamilnadu	Chennai	RIRuO		9	L	15	L	59	M
	Coimbatore	RIRuO		5	L	27	M	78*	H
	Madurai	RIRuO		11	L	25	M	47	M
	Salem	RIRuO		8	L	26	M	85*	H
	Tuticorin	RIRuO		12	L	12	L	119*	C
Uttar Pradesh	Agra	ES	Taj-trapezi-um	5	L	20	M	185*	C
	Allahabad	RIRuO		4	L	24	M	218*	C
	Anpara	RIRuO		17	L	28	M	128*	C
	Ferozabad	ES	Taj-trapezi-um	16	M	33	H	214*	C
	Gajraula	RIRuO		16	L	22	M	87*	H
	Ghaziabad	RIRuO		30	M	37	M	290*	C
	Jhansi	RIRuO		9	L	25	M	118*	C
	Kanpur	RIRuO		7	L	34	M	203*	C
	Khurja	RIRuO		29	M	27	M	173*	C
	Lucknow	RIRuO		8	L	34	M	204*	C
	Meerut	RIRuO		8	L	47*	H	166*	C
	Muradabad	RIRuO		11	-	21	-	195*	-
	Noida	RIRuO		11	L	46*	H	132*	C
	Varanasi	RIRuO		18	L	20	L	127*	-

State	City	Type of station	Category of ESA	SO <sub>2</sub>		NO <sub>2</sub>		PM <sub>10</sub>	
				Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality
Uttarakhand	Dehradun	ES	Doon valley	28*	H	30	M	162*	C
	Haldwani	RIRuO		-	-	-	-	196*	-
	Haridwar	RIRuO		-	-	-	-	139*	-
	Kashipur	RIRuO		-	-	-	-	46	-
	Rishikesh	ES	Hill station	-	-	-	-	212*	C
West Bengal	Asansol	RIRuO		8	L	66*	C	141*	C
	Barrackpore	RIRuO		12	L	74*	C	121*	C
	Durgapur	RIRuO		8	L	66*	C	141*	C
	Halda	RIRuO		14	L	52*	H	57	M
	Howrah	RIRuO		12	L	75*	C	118*	C
	Kolkata	RIRuO		11	L	62*	C	99*	C
	Raniganj	RIRuO		8	L	63*	C	159*	C
	Sankrail	RIRuO		10	L	65*	C	100*	C
	South Suburban	RIRuO		7	L	56*	H	82*	H

L: Low, M: Moderate, H: High, C: Critical; Low, moderate, high, critical classification based on Pollution Level Classification, Chapter 2, Table 2.1;

‘-’ No monitoring/Monitoring not conducted; \* - exceeding NAAQS; Data of monitoring stations with monitoring days less than 50 has also been considered For LMHC classification cities with monitoring days only  $\geq 50$  has been considered.

**Table 2.5: b. Ambient Air Quality in different cities for the year 2010**  
(ecologically sensitive areas)

State	City	Type of station	Category of ESA	SO <sub>2</sub>		NO <sub>2</sub>		PM <sub>10</sub>	
				Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality
Assam	Golaghat	ES	Numaligarh	6	L	15	L	73*	C
Goa	Honda	ES	Sahyadri	8	L	25	M	100*	C
Himachal Pradesh	Shimla	ES	Hill station	3	L	13	L	58	M
Karnataka	Belgaum	ES	Sahyadri	2	L	15	L	33	M
Maharashtra	Kolhapur	ES	Sahyadri	15	M	22	M	83*	H
Meghalaya	Shillong	ES	Hill station	2	L	10	L	79*	H
Mizoram	Aizawl	ES	Hill station	2	L	6	L	42	M

State	City	Type of station	Category of ESA	$\text{SO}_2$		$\text{NO}_2$		$\text{PM}_{10}$	
				Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality
Nagaland	Kohima	ES	Hill station	2	L	5	L	66*	H
Rajasthan	Alwar	ES	Aravali range	8	L	24	M	225*	C
Uttar Pradesh	Agra	ES	Taj-trapezium	5	L	20	M	185*	C
	Ferozabad	ES	Taj-trapezium	16	M	33	H	214*	C
Uttarakhand	Dehradun	ES	Doon valley	28*	H	30	M	162*	C
	Rishikesh	ES	Hill station	-	-	-	-	212*	C

*L: Low, M: Moderate, H: High, C: Critical; Low, moderate, high, critical classification based on Pollution Level Classification, Chapter 2, Table 2.1; '-' No monitoring: Monitoring not conducted; \*- exceeding NAAQS; Data of monitoring stations with monitoring days less than 50 has also been considered.*

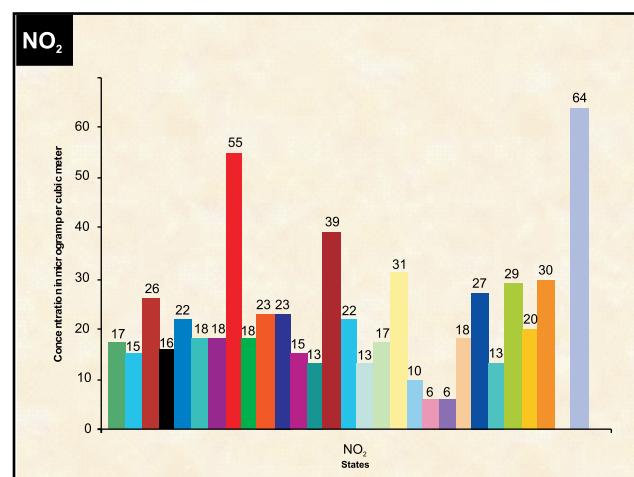
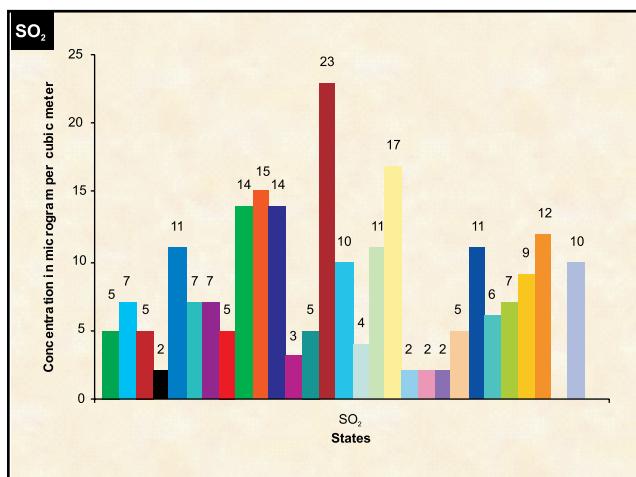
## **2.4 Annual average concentration of pollutants in different States and Union territories**

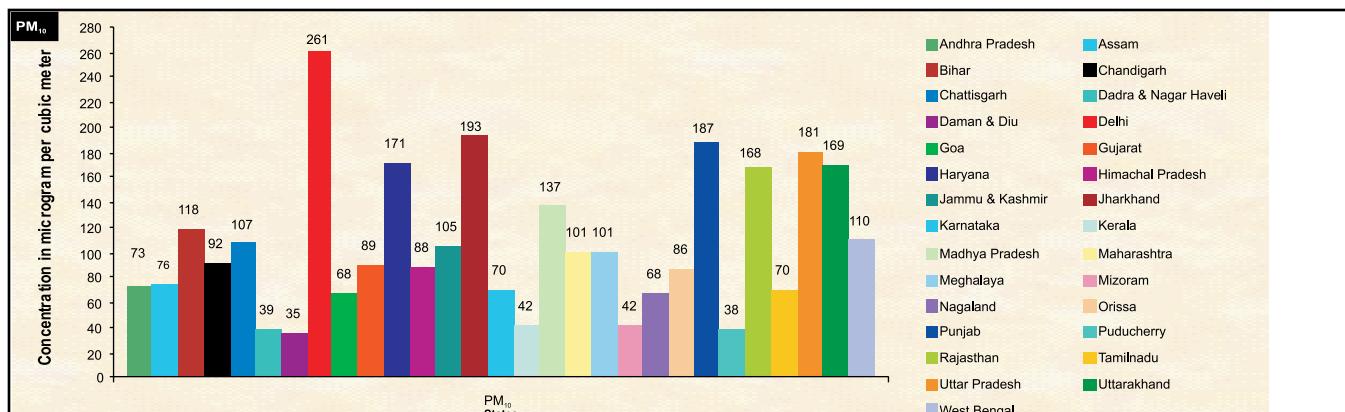
The analysis of three pollutants (combining residential/industrial/rural/other and sensitive area; only data with number of monitoring days greater than or equal to 50 days has been considered) during 2010 in each state revealed that with respect to  $\text{SO}_2$ , Jharkhand had the maximum annual average concentration ( $23 \mu\text{g}/\text{m}^3$ ) followed by Maharashtra ( $17 \mu\text{g}/\text{m}^3$ ). With respect to  $\text{NO}_2$ , West Bengal had the maximum annual average concentration ( $64 \mu\text{g}/\text{m}^3$ ) followed by Delhi ( $55 \mu\text{g}/\text{m}^3$ ). With respect to  $\text{PM}_{10}$ , Delhi had the maximum annual average concentration ( $261 \mu\text{g}/\text{m}^3$ ) followed by Jharkhand ( $193 \mu\text{g}/\text{m}^3$ ). Table 2.6 shows the top 2 states with highest criteria pollutants and Table 2.7, Figure 2.5 shows the annual average concentration of states in India.

**Table 2.6: The states having high annual averages of criteria pollutants**

<b>SO<sub>2</sub></b>		<b>NO<sub>2</sub></b>		<b>PM<sub>10</sub></b>	
<b>State</b>	<b>Conc. µg/m<sup>3</sup></b>	<b>State</b>	<b>Conc. µg/m<sup>3</sup></b>	<b>State</b>	<b>Conc. µg/m<sup>3</sup></b>
Jharkhand	23	West Bengal	64	Delhi	261
Maharashtra	17	Delhi	55	Jharkhand	193

**Figure 2.5: Annual average concentration in States and UTs of India**





**Table 2.7: Annual average concentration of criteria pollutants in states  
(residential/industrial/rural/other and sensitive area)**

States & Union territories	SO <sub>2</sub>		NO <sub>2</sub>		PM <sub>10</sub>	
	Annual average (µg/m <sup>3</sup> )	Standard deviation	Annual average (µg/m <sup>3</sup> )	Standard deviation	Annual average (µg/m <sup>3</sup> )	Standard deviation
Andhra Pradesh	5	2	17	4	73	24
Assam	7	1	15	2	76	51
Bihar	5	2	26	9	118	80*
Chandigarh	2	0	16	7	92	56
Chhattisgarh	11	1	22	2	107	14
Dadra & Nagar Haveli	7	0	18	1	39	27
Daman & Diu	7	0	18	1	35	21
Delhi	5	2	55	13	261	130*
Goa	14	15	18	10	68	36
Gujarat	15	3	23	3	89	15
Haryana	14	4	23	6	171	73*
Himachal Pradesh	3	1	15	4	88	39
Jammu & Kashmir	5	2	13	4	105	41
Jharkhand	23	3	39	4	193	67*
Karnataka	10	6	22	5	70	35
Kerala	4	1	13	3	42	16
Madhya Pradesh	11	6	17	6	137	57
Maharashtra	17	7	31	11	101	40
Meghalaya	2	1	10	4	101	15
Mizoram	2	0	6	1	42	10
Nagaland	2	0	6	2	68	42
Orissa	5	1	18	3	86	25
Punjab	11	2	27	5	187	37
Puducherry	6	2	13	3	38	12
Rajasthan	7	2	29	6	168	99*
Tamilnadu	9	3	20	8	70	39
Uttar Pradesh	12	6	30	11	181	111*
Uttarakhand	-	-	-	-	169	36
West Bengal	10	4	64*	19	110	70*

**NB.** - 'inadequate data \*-exceeding NAAQS , Data of monitoring stations with monitoring days greater than or equal to 50 has been considered

## 2.5 Exceedence of pollutants from National ambient Air Quality Standard

### 2.5.1. Locations exceeding NAAQS

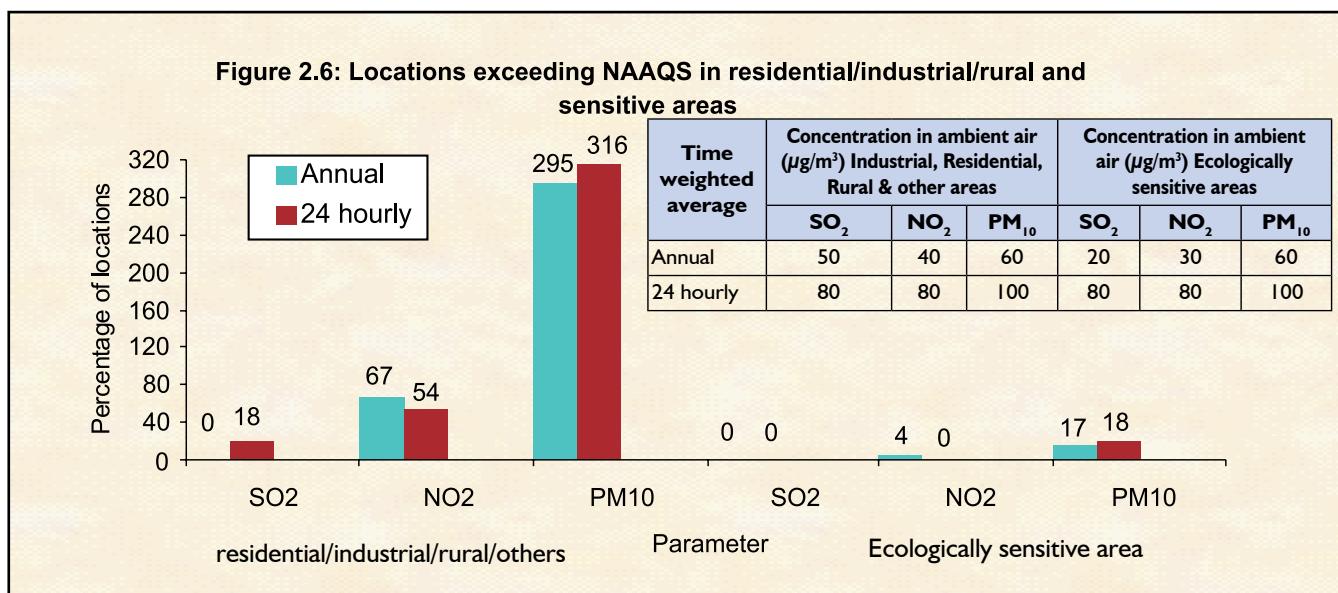
Number of monitoring stations (with adequate data) exceeding NAAQS is presented in Table 2.8, Figure 2.6. For residential/industrial/rural area, taking annual average into consideration, 67 stations (for  $\text{NO}_2$ ) and 295 stations (for  $\text{PM}_{10}$ ) exceed NAAQS. No location exceeds NAAQS for  $\text{SO}_2$ . Considering 24-hourly average data into consideration, 11 stations (for  $\text{SO}_2$ ), 57 stations (for  $\text{NO}_2$ ) and 241 stations (for  $\text{PM}_{10}$ ) exceed NAAQS. For sensitive area, considering annual average into consideration, 4 stations (for  $\text{NO}_2$ ) and 17 stations (for  $\text{PM}_{10}$ ) stations exceed NAAQS. Considering 24-hourly average data, 19 stations (for  $\text{SO}_2$ ), 54 stations (for  $\text{NO}_2$ ), and 316 stations (for  $\text{PM}_{10}$ ) exceed NAAQS for residential/industrial/rural area.

**Table 2.8. Number of locations exceeding the NAAQS**

(Based on annual average data and 24-hourly data in  $\mu\text{g}/\text{m}^3$ )

	Residential/Industrial/Rural area						Sensitive area					
	$\text{SO}_2$		$\text{NO}_2$		$\text{PM}_{10}$		$\text{SO}_2$		$\text{NO}_2$		$\text{PM}_{10}$	
	Annual >50	24 hourly >80	Annual >40	24 hourly >80	Annual >60	24 hourly >100	Annual >20	24 hourly >80	Annual >30	24 hourly >80	Annual >60	24 hourly >100
Not exceeding NAAQS	360	342	295	308	64	43	25	25	20	24	9	8
Exceeding NAAQS	0	18	67	54	295	316	0	0	4	0	17	18
Inadequate data	38	38	37	37	42	42	4	4	5	5	5	5
No monitoring	3	3	3	3	1	1	2	2	2	2	0	0
Total (NE & E)	360	360	362	362	359	359	25	25	24	24	26	26
Grand total stations	401	401	402	402	402	402	31	31	31	31	31	31

**NB.** NE/E: not exceedingNAAQS / exceeding the NAAQS



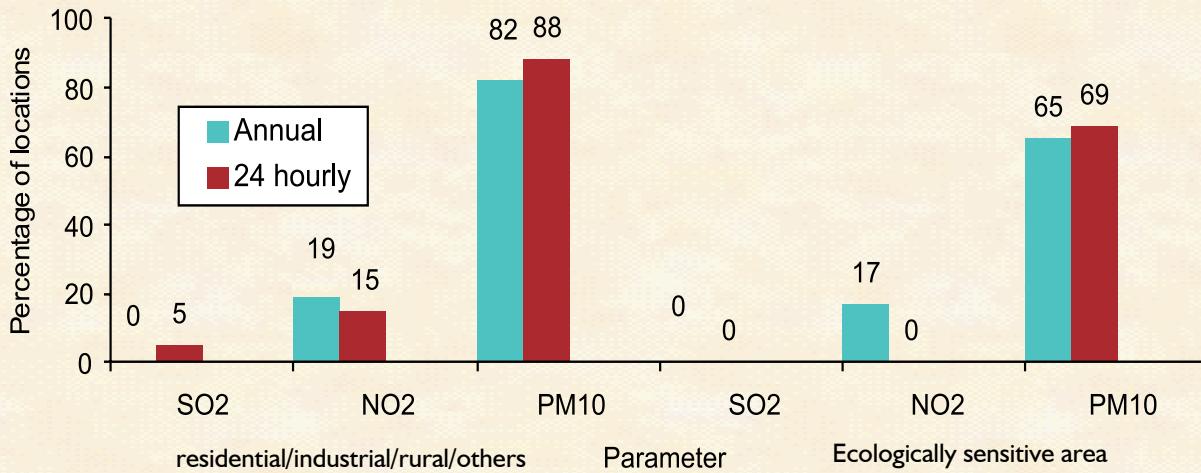
The percentage of locations exceeding national standards with respect to  $\text{NO}_2$ ,  $\text{SO}_2$  and  $\text{PM}_{10}$  is depicted in Table 2.9, Figure 2.7. For residential/industrial/rural area, considering annual average no location for  $\text{SO}_2$ , 19% station (for  $\text{NO}_2$ ) and 82% ( $\text{PM}_{10}$ ) stations exceed NAAQS. Considering 24-hourly average data into consideration, 5% station (for  $\text{SO}_2$ ), 15% ( $\text{NO}_2$ ) stations and 88% stations ( $\text{PM}_{10}$ ) exceed NAAQS. In case of sensitive area considering annual average into 17% station (for  $\text{NO}_2$ ) and 65% ( $\text{PM}_{10}$ ) stations exceed NAAQS. Considering 24-hourly average data into consideration, 69% station ( $\text{PM}_{10}$ ) exceed NAAQS.  $\text{SO}_2$  does not exceed the standard for both annual average and 24-hourly data and  $\text{NO}_2$  does not exceed taking 24-hourly data into consideration.

**Table 2.9: Percentage of locations exceeding the NAAQS**

(Based on annual average data and 24-hourly data in  $\mu\text{g}/\text{m}^3$ )

% of locations	Residential/Industrial/Rural area						Sensitive area					
	$\text{SO}_2$		$\text{NO}_2$		$\text{PM}_{10}$		$\text{SO}_2$		$\text{NO}_2$		$\text{PM}_{10}$	
	Annual >50	24 hourly >80	Annual >40	24 hourly >80	Annual >60	24 hourly >100	Annual >20	24 hourly >80	Annual >30	24 hourly >80	Annual >60	24 hourly >100
Not exceeding NAAQS	100	95	81	85	18	12	100	100	83	100	35	31
Exceeding NAAQS	0	5	19	15	82	88	0	0	17	0	65	69

**Figure 2.7: Percentage of locations exceeding NAAQS in residential/industrial/rural and sensitive areas**



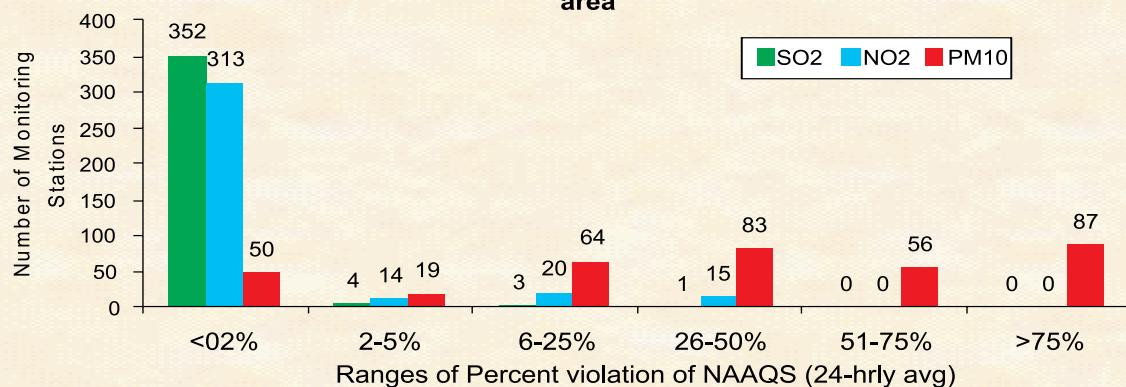
Number and percentage of monitoring stations in various ranges of percentage exceedence of NAAQS (24 hourly average) of  $\text{PM}_{10}$  is depicted in Table 2.10. The percentage exceedence of NAAQS for residential/industrial/rural/other area was less than 2% at 353 (88%) monitoring stations for  $\text{SO}_2$ , 313 (78%) monitoring stations for  $\text{NO}_2$  and 50 (12%) monitoring stations for  $\text{PM}_{10}$  out of 402 stations. Therefore it can be mentioned that considering daily average values the exceedence from NAAQS for  $\text{SO}_2$  was minimum followed by  $\text{NO}_2$  and was maximum for  $\text{PM}_{10}$ . (Figure 2.8). As for sensitive areas was less than 2% at 25 (81%) monitoring stations for  $\text{SO}_2$  and  $\text{NO}_2$  and 1 (7%) monitoring stations for  $\text{PM}_{10}$  out of 14 stations (Figure 2.9).

**Table 2.10: Number and percentage of locations in different ranges of percent exceedance**

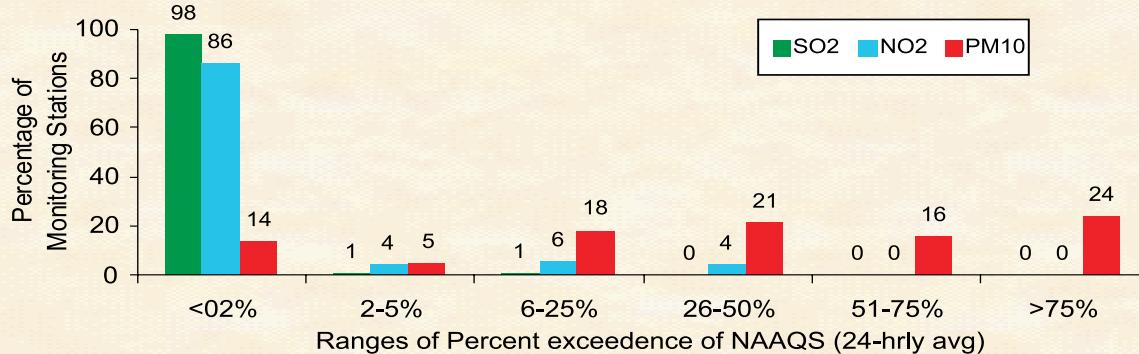
Ranges of percent exceedence	Residential/Industrial/rural/other area						Sensitive area					
	SO <sub>2</sub>		NO <sub>2</sub>		PM <sub>10</sub>		SO <sub>2</sub>		NO <sub>2</sub>		PM <sub>10</sub>	
	no.of station	% of station	no.of station	% of station	no.of station	% of station	no.of station	% of station	no.of station	% of station	no.of station	% of station
<2	352	98	313	86	50	14	25	100	24	100	8	31
2-5	4	1	14	4	19	5	0	0	0	0	0	0
6-25	3	1	20	6	64	18	0	0	0	0	3	12
26-50	1	0	15	4	83	23	0	0	0	0	2	8
51-75	0	0	0	0	56	16	0	0	0	0	5	19
>75	0	0	0	0	87	24	0	0	0	0	8	31
Total (NE/E)	360	100	362	100	359	100	25	100	24	100	26	100

**NB.** NE/E: not exceeding/exceeding the NAAQS

**Figure 2.8: Number of monitoring stations in various ranges of percent exceedence for SO<sub>2</sub>, NO<sub>2</sub> and PM<sub>10</sub> in residential/industrial/rural/other area**



**Figure 2.9: Percentage of monitoring stations in various ranges of percent exceedence for SO<sub>2</sub>, NO<sub>2</sub> and PM<sub>10</sub> in 10 in residential/industrial/rural/other**



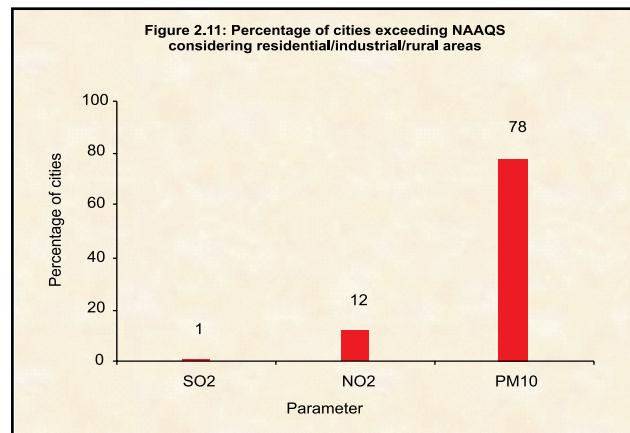
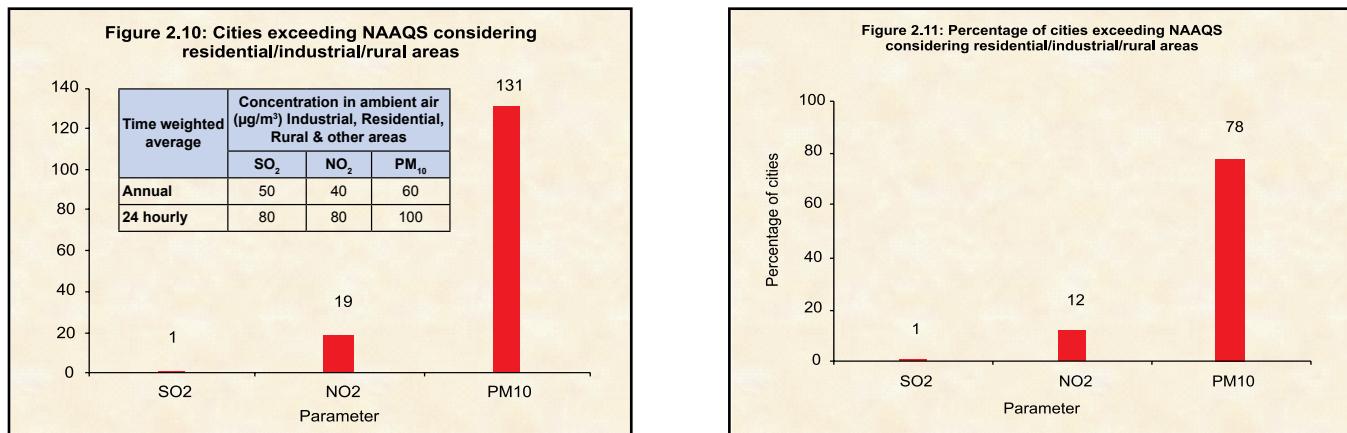
### 2.5.2. Cities exceeding NAAQS

Number and percentage of cities exceeding NAAQS is presented in Table 2.11, Figure 2.10 and 2.11. Considering residential/industrial/rural area, 2 cities (1% for SO<sub>2</sub>), 19 cities (12% for NO<sub>2</sub>) and 131 cities (78% for PM<sub>10</sub>) exceed NAAQS. Considering sensitive area, 1 (8%) cities exceed NAAQS for SO<sub>2</sub> and NO<sub>2</sub> and 10 (77%) exceed for PM<sub>10</sub> respectively.

**Table 2.11. Number of cities exceeding the NAAQS**  
(Based on annual average data)

	Residential/Industrial/Rural area			Ecologically sensitive area		
	$\text{SO}_2 > 50$	$\text{NO}_2 > 40$	$\text{PM}_{10} > 60$	$\text{SO}_2 > 20$	$\text{NO}_2 > 30$	$\text{PM}_{10} > 60$
Not exceeding NAAQS	163 (99)	146 (88)	36 (22)	11 (92)	11 (92)	3 (23)
Exceeding NAAQS	1 (1)	19 (12)	131 (78)	1 (8)	1 (8)	10 (77)
Total cities	164	165	167	12	12	13

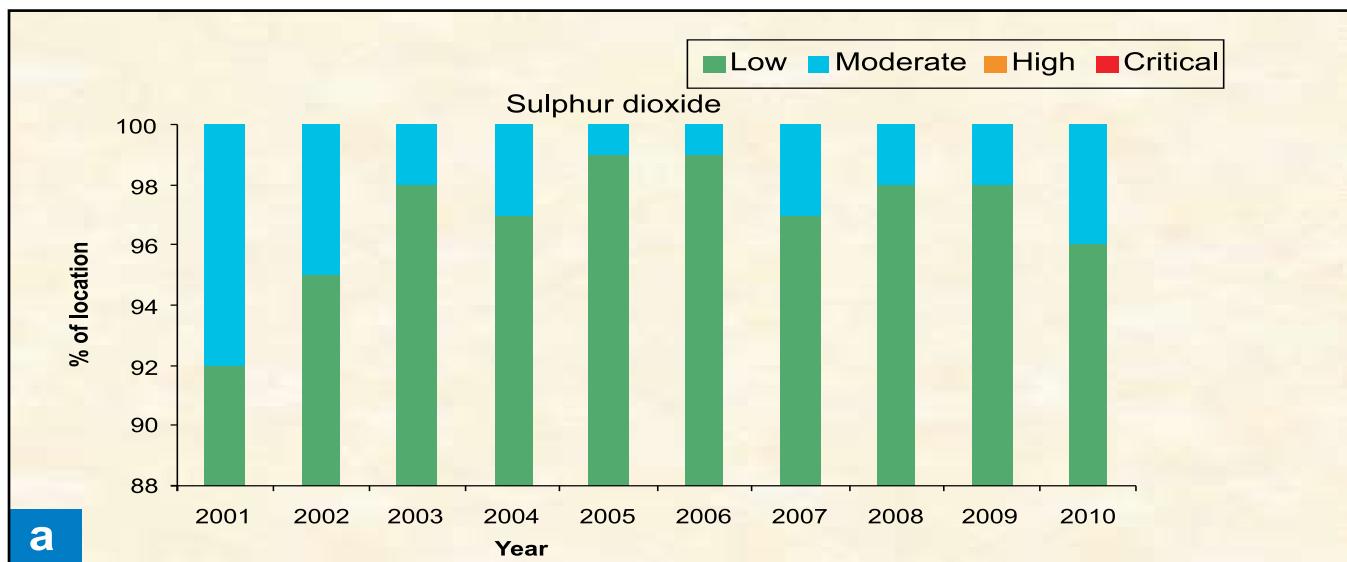
NB. Figures in parenthesis indicate percentage

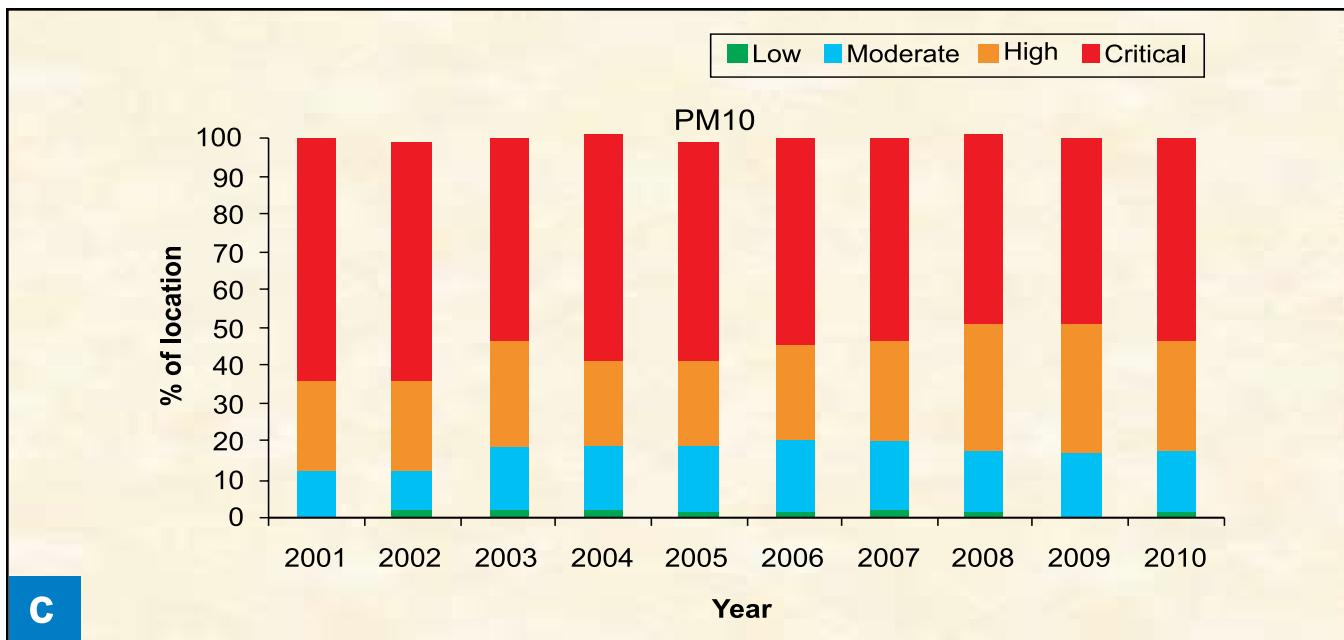
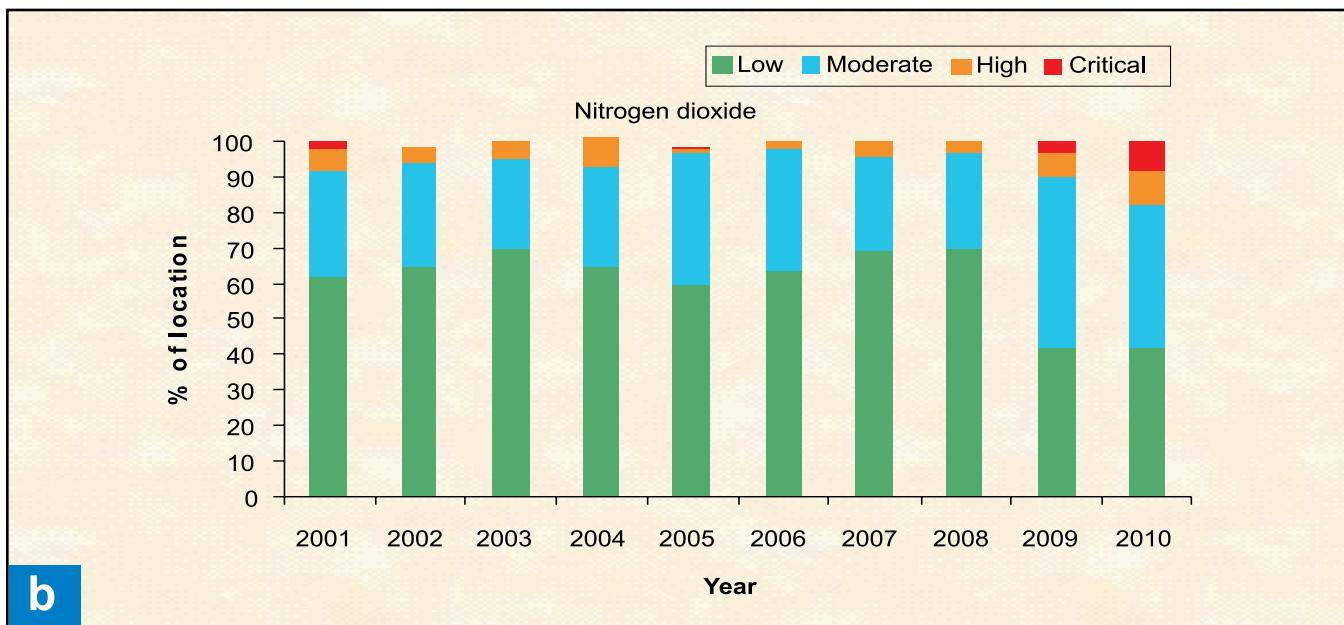


## 2.6 Percentage of residential/industrial/rural/other location in different pollution categories

Trend in percentage of locations (Residential areas till 2009 and residential/industrial/rural/others for 2010, adequate data) with low, moderate, high and critical levels of  $\text{SO}_2$ ,  $\text{NO}_2$ ,  $\text{PM}_{10}$  is depicted in Figure 2.10. With respect to  $\text{SO}_2$ , percentage of locations are limited to low and moderate category though fluctuating over the years. This indicates a low  $\text{SO}_2$  pollution level (Figure 12.10a).  $\text{NO}_2$  levels showed a reduction in the low category and an increase in moderate, high and critical level indicating an increase in the pollution level (Figure 12.10b). Location with respect to  $\text{PM}_{10}$  showed similar trend in 2010 with a reduction in the low category (Figure 12.10c)

**Figure 2.12: Yearly Trends of Low, Moderate, High and Critical levels of a.  $\text{SO}_2$ , b.  $\text{NO}_2$  and c.  $\text{PM}_{10}$  (Residential areas; percentage of location)**

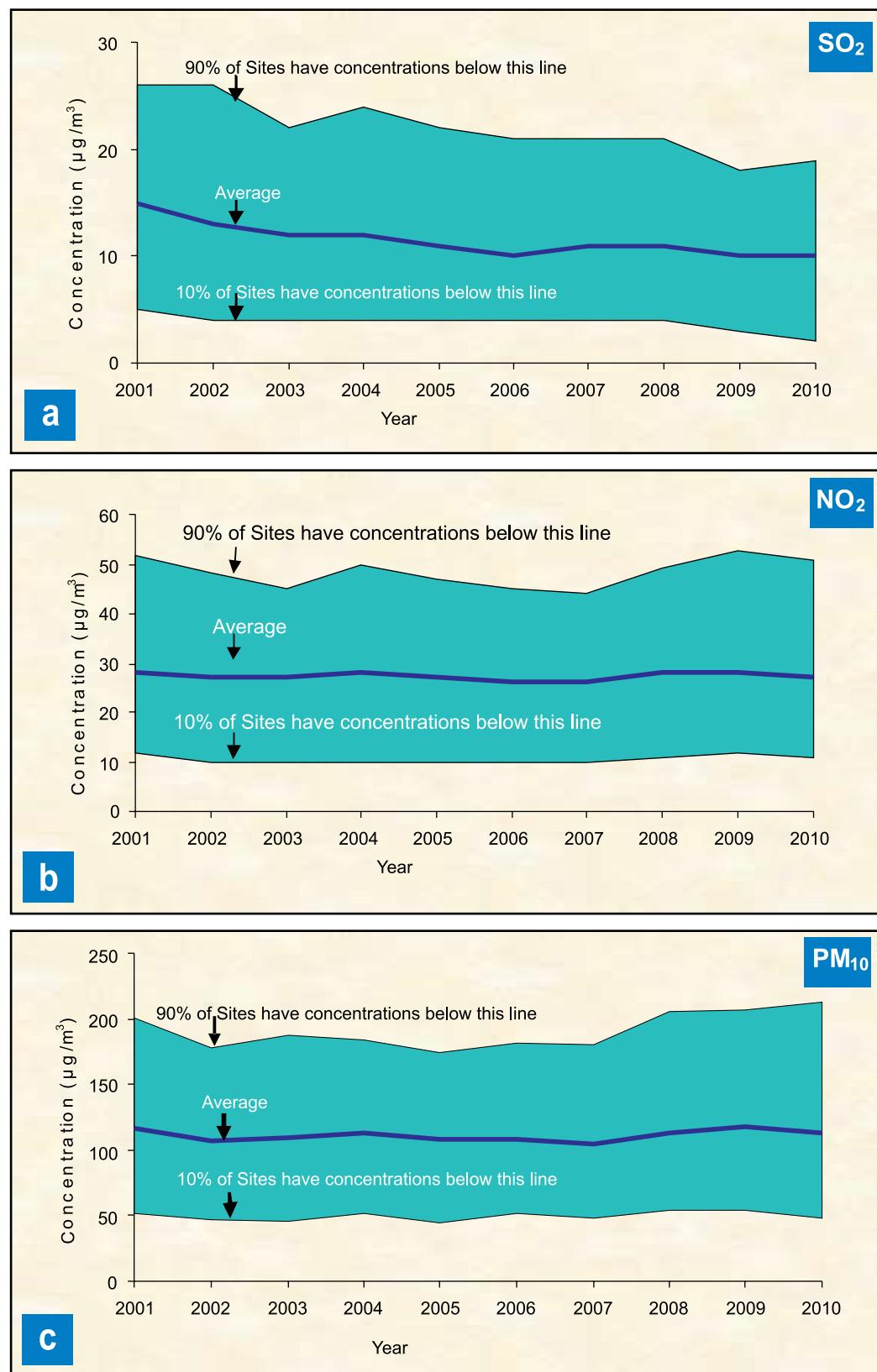




## 2.7 National Mean Concentration

National mean concentration with 90<sup>th</sup> percentile and 10<sup>th</sup> percentile for SO<sub>2</sub>, NO<sub>2</sub> and PM<sub>10</sub> is depicted in Figure 2.13. National mean of SO<sub>2</sub> concentration has decreased over the years indicating that there has been a decline in SO<sub>2</sub> levels (Figure 2.13a). Decreasing trend may be due to various intervention that have taken place in recent years such as reduction in sulphur in diesel, use of cleaner fuel such as CNG in metro cities, change in domestic fuel from coal to LPG etc. National mean of NO<sub>2</sub> concentration has remained stable over the years despite increase in sources like vehicles (Figure 2.13b). The reason for this may be various intervention measures that have taken place such as improvement in vehicle technology and other vehicular pollution control measures like alternate fuel etc. National mean of PM<sub>10</sub> concentration shows fluctuating trend (Figure 2.13b). The reasons being emission from gensets, small scale industries, biomass incineration, suspension of traffic dust, natural dust, commercial and domestic use of fuel and vehicular emission etc.

**Figure 2.13: National mean concentration of different locations that fall under 10<sup>th</sup> and 90<sup>th</sup> percentile for SO<sub>2</sub>, NO<sub>2</sub> and PM<sub>10</sub>**



Sulphur dioxide ( $\text{SO}_2$ ) is a colourless, soluble gas with a characteristic pungent smell. It is the chemical compound produced by volcanoes and in various industrial processes and are also a precursor to particulates in the atmosphere. Its natural source is volcanic eruptions (67%) and anthropogenic sources are combustion of fossil fuel (coal, heavy fuel oil in thermal power plants, office, factories), paper Industry, extraction & distribution of fossil fuels, smelting of metals (sulfide ores to produce copper, lead and zinc), petroleum refining, combustion process in diesel, petrol, natural gas driven vehicles.  $\text{SO}_2$  in ambient air can also affect human health, particularly in those suffering from asthma and chronic lung diseases and exacerbates respiratory symptoms and impaired breathing in sensitive individuals. It also causes visibility impairment. It is considered more harmful when particulate and other pollution concentrations are high.  $\text{SO}_2$  also causes acid rain and aesthetic damage. A compilation of sources and effects of  $\text{SO}_2$  are given in Annexure I.

In this chapter a detailed summary of  $\text{SO}_2$  levels in the country is furnished. The air quality of different cities/towns has been compared with the respective NAAQS. The air quality has been categorized into four broad categories based on an Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard. The four categories are low, moderate, high and critical levels. The top 10 location, cities and states with maximum  $\text{SO}_2$  pollution is given.

### 3.1 Locations, cities and states with highest $\text{SO}_2$ values during 2010

Table 3.1 shows top ten locations in terms of annual average concentration of  $\text{SO}_2$  for residential / industrial / rural / other area in which highest concentration was observed at Bhosari, Pune, Maharashtra. Table 3.2 shows sensitive area in which the highest concentration was observed at Ruikar Trust, Kolhapur, Maharashtra. Among the cities Jamshedpur, Jharkhand tops the list with  $35.4 \mu\text{g}/\text{m}^3$   $\text{SO}_2$  (Table 3.3). Among the states Jharkhand shows highest  $\text{SO}_2$  values  $23.2 \mu\text{g}/\text{m}^3$  (Table 3.4).

**Table 3.1: Ten locations with highest  $\text{SO}_2$  values (annual average) during 2010**  
(residential / industrial / rural / other area)

Sl. No.	State	City	Location	Station code	No. of mon. days (n)	Min	Max	Annual average ( $\mu\text{g}/\text{m}^3$ )	Std. Dev.	% exceedence (24 hourly)	Air Quality
1	Maharashtra	Pune	Bhosari	312	104	11	195	39.7	28	10	M
2	Maharashtra	Chandrapur	MIDC Chandrapur	281	96	6	181	38.4	36	13	M
3	Jharkhand	Jamshedpur	Bistupur	351	89	30	41	35.6	-	0	M
4	Jharkhand	Jamshedpur	Golmuri	382	91	23	42	35.2	3	0	M
5	Jharkhand	Saraikela Kharsawan	Adityapur	614	86	28	41	35.0	3	0	M
6	Uttar Pradesh	Khurja	CGCRI	534	58	24	42	33.2	4	0	M
7	Maharashtra	Ulhasnagar	Octroi Naka	648	94	5	132	32.4	21	4	M
8	Maharashtra	Badlapur	BIWA House	649	92	5	86	32.3	15	1	M
9	Goa	Marmagao	Fire Brigade	435	118	7	253	31.8	35	6	M
10	Uttar Pradesh	Ghaziabad	Sahibabad	258	97	25	39	31.1	3	0	M

\* - Locations where annual mean concentration of  $\text{SO}_2$  exceeded the NAAQS of  $50 \mu\text{g}/\text{m}^3$  for Residential/ industrial / other area. Std. dev:standard deviation, mon:monitoring, n:number of monitoring days; L:Low, M:moderate, H:high, C:critical classification based on Pollution Level Classification, Chapter 2, Table 2.. Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

**Table 3.2: Ten locations with highest SO<sub>2</sub> values (annual average) during 2010**  
 (Ecologically sensitive area)

Sl. No.	State	City	Location	Station code	ESA category	No. of mon. days (n)	Min	Max	Annual average ( $\mu\text{g}/\text{m}^3$ )	Std. Dev.	% exceedence (24 hourly)	Air Quality
1	Maharashtra	Kolhapur	Ruikar Trust	509	Sahyadri	92	15	32	20.0	4	0	M
2	Uttar Pradesh	Ferozabad	CDGI	399	Taj-trapezium	104	8	32	16.9	23	0	M
3	Maharashtra	Kolhapur	Mahadwar Road	510	Sahyadri	102	10	24	16.3	3	0	M
4	Uttar Pradesh	Ferozabad	Tilak Nagar	400	Taj-trapezium	103	7	24	15.7	22	0	M
5	Uttar Pradesh	Ferozabad	Raza ka Tal	401	Taj-trapezium	101	7	25	15.3	21	0	M
6	Uttar Pradesh	Agra	Nunhai	324	Taj-trapezium	79	7	13	9.8	11	0	L
7	Uttar Pradesh	Agra	RO, Bodla	323	Taj-trapezium	80	7	12	9.3	11	0	L
8	Rajasthan	Alwar	Gaurav Solvex	373	Aravali range	75	4	24	9.0	4	0	L
9	Maharashtra	Kolhapur	Shivaji University	508	Sahyadri	100	7	11	8.7	1	0	L
10	Rajasthan	Alwar	RIICO Pump House	219	Aravali range	72	4	24	7.9	4	0	L

\* - Locations where annual mean concentration of SO<sub>2</sub> exceeded the NAAQS of 20  $\mu\text{g}/\text{m}^3$  for Residential / industrial / other area. Std. dev:standard deviation, mon:monitoring, n:number of monitoring days; L:Low, M:moderate, H:high, C:critical classification based on Pollution Level Classification, Chapter 2, Table 2.1 Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

**Table 3.3: Ten cities with highest SO<sub>2</sub> values (annual average) during 2010**  
 (residential / industrial / rural / other area)

Sl. No.	State	City	Min	Max	Annual average ( $\mu\text{g}/\text{m}^3$ )	Std. Dev.	Air Quality
1	Jharkhand	Jamshedpur	27	42	35.4	1	M
2	Jharkhand	Saraikela Kharsawan	28	41	35.0	3	M
3	Maharashtra	Badlapur	5	86	32.3	15	M
4	Goa	Marmagao	7	253	31.8	35	M
5	Maharashtra	Ulhasnagar	5	109	31.2	17	M
6	Uttar Pradesh	Ghaziabad	21	37	30.3	3	M
7	Uttar Pradesh	Khurja	21	40	29.2	4	M
8	Maharashtra	Pune	10	96	28.7	15	M
9	Maharashtra	Chandrapur	12	35	21.3	4	L
10	Jharkhand	West Singhbhum	15	36	21	3	L

\* - Locations where annual mean concentration of SO<sub>2</sub> exceeded the NAAQS of 50  $\mu\text{g}/\text{m}^3$  for Residential/ industrial / other area. Std. dev:standard deviation, mon:monitoring, n:number of monitoring days; L:Low, M:moderate, H:high, C:critical classification based on Pollution Level Classification, Chapter 2, Table 2.1, Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

**Table 3.4: Ten states with highest SO<sub>2</sub> values (annual average) during 2010**  
 (residential / industrial / rural / other & ecologically sensitive area)

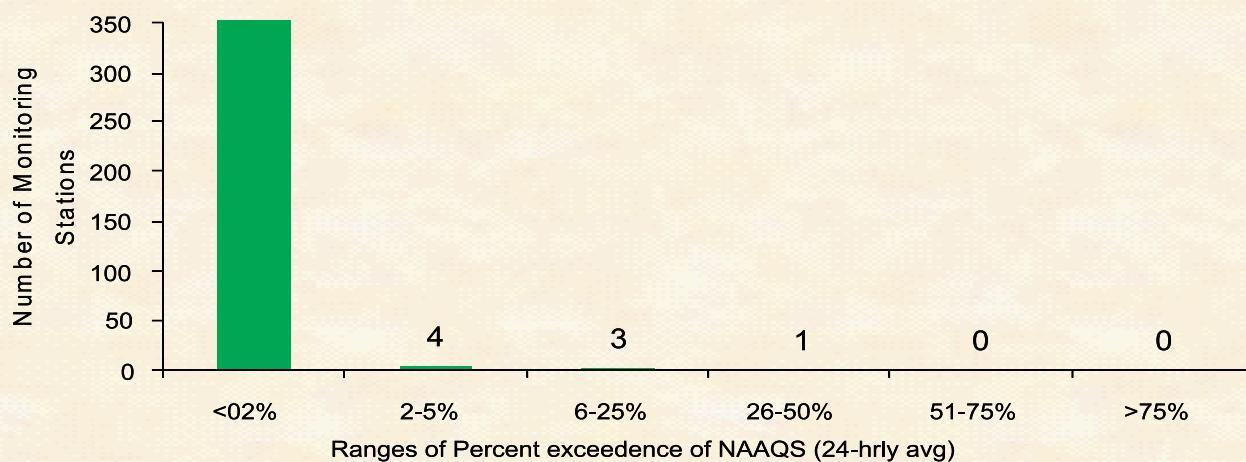
Sl. No.	State	Min	Max	Annual average ( $\mu\text{g}/\text{m}^3$ )
1	Jharkhand	18	37	23.2
2	Maharashtra	7	41	16.5
3	Gujarat	10	24	15.5
4	Goa	4	111	13.8
5	Haryana	7	24	13.7
6	Uttar Pradesh	8	20	12.1
7	Madhya Pradesh	14	21	11.3
8	Chattisgarh	9	13	10.9
9	Punjab	6	17	10.6
10	West Bengal	5	25	10.3

\* - Locations where annual mean concentration of SO<sub>2</sub> exceeded the NAAQS of 50  $\mu\text{g}/\text{m}^3$  for Residential/ industrial /other area., Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

### 3.2 Percentage exceedence of NAAQS (24 Hourly Average)

Number of monitoring stations in various ranges of percentage exceedence of NAAQS (24 hourly average) of SO<sub>2</sub>, is depicted in Figure 3.1. The percentage exceedence of NAAQS (24 hourly Average) was less than 2% at 353 monitoring stations out of 361 stations with adequate data. In the remaining stations (8 stations), the percentage exceedence of NAAQS (24 hourly avg.) was 2% or more.

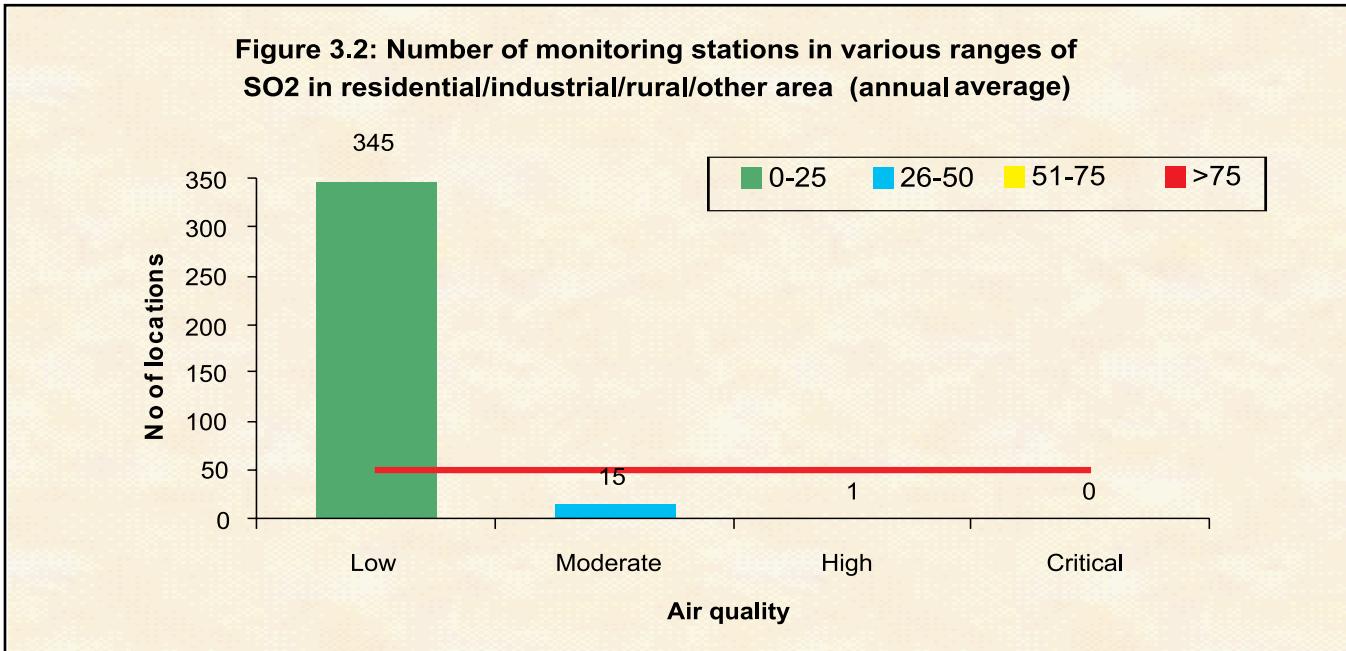
**Figure 3.1: Number of monitoring stations in various (residential / industrial / rural / other) ranges of percent violation of SO<sub>2</sub> (24 hourly average)**



NB. Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

### 3.3 Air Quality (Low, Moderate, High & Critical)

Number of monitoring stations with low, moderate, high and critical levels of  $\text{SO}_2$  is depicted in Figure 3.2. 345 locations showed low  $\text{SO}_2$  level, 15 locations showed moderate and 1 location fall under high pollutin category. None of the location were in the critical category.



NB. Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

**Table 3.5: SO<sub>2</sub> levels (Annual average) in Ambient Air Quality Stations under NAMP during 2010**

State	City	Location	Type	Air Quality					
				% exceedence (24 hourly)					
				Std. Dev.					
				90 percentile					
				50 percentile					
				10 percentile					
Andhra Pradesh	Hyderabad	GNC Toll Gate Tirumala	582	RIRuO	93	A	4	4	-
		Near Hindu College, Market Road	583	RIRuO	102	A	2	2	0
		Tanaka, NEERI Lab.	150	RIRuO	94	A	2	2	0
		Nacharam, Industrial Estate	151	RIRuO	88	A	2	7	0
		ABIDS Circle General Post Office Building	152	RIRuO	92	A	3	11	0
		Balanagar	95	RIRuO	108	A	4	6	0
	Visakhapatnam	Uppal, IDA	203	RIRuO	108	A	4	6	0
		Jubilee Hills	365	RIRuO	108	A	4	5	0
		Paradise	393	RIRuO	108	A	4	6	0
		Charminar	394	RIRuO	108	A	4	6	0
		Zoo Park	470	RIRuO	107	A	4	5	0
		Kothagudem	581	RIRuO	103	A	2	2	0
	Kurnool	Mouriya Inn	466	RIRuO	118	A	4	4	0
		RO, APPCB	577	RIRuO	108	A	4	5	0
		Nellore	580	RIRuO	94	A	2	2	0
		Patancheru	468	RIRuO	98	A	7	17	0
		Ramagundam	465	RIRuO	98	A	2	13	0
		Karimnagar Godavarkhani	389	RIRuO	104	A	4	4	0
Vijaywada	Tirupati	Regional Science Centre, Chittoor Bypass Road							
		Benz Circle	462	RIRuO	113	A	2	7	0
		Vijaywada Autonagar	469	RIRuO	113	A	3	15	0
		KUDA Office, Hanumakonda	579	RIRuO	102	A	2	18	0
		Panchayat Raj office, Mindi	234	RIRuO	108	A	4	127	0
	Warangal	Industrial Estate, Marripalem	233	RIRuO	108	A	4	24	0
		Police Barracks	371	RIRuO	108	A	4	17	0
		INS-Virabahu, Naval Area	387	RIRuO	108	A	4	27	0
		Seethammadhara	388	RIRuO	107	A	4	18	0
		Ganapuram Area	467	RIRuO	108	A	4	61	0
CWWMP, RAMKY, Parawada	Pedlagantyada, Gajuwada	584	RIRuO	117	A	4	15	7	0
	CWWMP, RAMKY, Parawada	585	RIRuO	108	A	4	16	5	0

State	City	Location	Type	Air Quality										
				% exceedence (24 hourly)				Std. Dev.						
90 percentile				50 percentile				10 percentile						
SO <sub>2</sub> Annual average (µg/m <sup>3</sup> )				Max	Min	A/IA	No. of mon. days (n)	Max	Min	A/IA	No. of mon. days (n)			
Bengaluru	Bengaluru	Oil India Ltd. Chirang	RIRuO	104	A	3	10	6	5	6	8			
Bengaluru	Bapara Office Building	542	RIRuO	104	A	3	10	7	5	7	8			
Daranga	BATAD, Baska	520	RIRuO	92	A	3	10	5	4	6	7			
Dibrugarh	Dibrugarh Office Building	566	RIRuO	103	A	4	10	6	5	6	8			
Golaghat	Golaghat Office Building	538	RIRuO	82	A	3	8	6	4	6	8			
	Head Office, Bramunimaidam	539	ES	Numaligarh	254	A	3	11	7	5	7			
	Boragaon, office premises of IASST, Kamrup	193	RIRuO	603	RIRuO	33	IA	3	11	6	5			
Guwahati	Guwahati University, Kamrup	602	RIRuO	82	A	3	8	6	5	6	7			
	ITI Building, Gopinath Nagar	519	RIRuO	280	A	4	15	9	8	9	11			
Assam	Central Dairy, Khanapara, Kamrup	596	RIRuO	106	A	4	10	6	6	6	7			
	Near Pragjyotish College, Santipur	541	RIRuO	264	A	5	13	7	5	7	9			
Lakhimpur	Bazar Patti, North Lakhimpur	587	RIRuO	102	A	4	10	6	5	6	8			
Nagaon	Water Resources Div., Christian Party	595	RIRuO	103	A	3	9	6	4	6	8			
Nalbari	PWD Rural Div Office Complex,	597	RIRuO	82	A	2	19	7	5	7	9			
Sibsagar	Sibsagar Office Building	537	RIRuO	108	A	3	8	6	4	6	8			
	Usha Lodge, near ONGCL Colony	604	RIRuO	24	IA	4	8	6	5	6	8			
Silchar	Janiganj Govt. Boys HS School	607	RIRuO	11	IA	5	7	6	5	6	7			
	Office Building of RLO, Ithkola Market	567	RIRuO	92	A	2	11	7	5	7	9			
Tezpur	Tezpur Office Building	536	RIRuO	104	A	4	8	6	5	6	7			
Tinsukia	Digboi Carbon factory Campus, Borguri	594	RIRuO	99	A	4	15	5	5	6	8			
	Coal India Office Complex, Margherita	586	RIRuO	97	A	7	29	10	8	10	12			
	Shreepuria, Borguri	605	RIRuO	43	IA	5	9	6	5	6	7			
Bihar	Patna	Belttron Bhawan, Shastri Nagar	210	RIRuO	80	A	2	10	5	3	5			
	Gandhi Maidan Test Centre	284	RIRuO	46	IA	4	28	9	4	7	18			
Chandigarh	Chandigarh	Modern Foods, Industrial Area	106	RIRuO	149	A	2	2	2	2	-			
	Sector-17 C	263	RIRuO	150	A	2	2	2	2	2	-			
	Punjab Engineering College, Sector 12	264	RIRuO	153	A	2	2	2	2	2	-			
	Sector-39, IMTECH	463	RIRuO	150	A	2	2	2	2	2	-			
	Kaimbwala Village	464	RIRuO	145	A	2	6	2	2	2	-			

State		City	Location	Air Quality		% exceedence (24 hourly)			
				Type	Station code	Std. Dev.	90 percentile	50 percentile	10 percentile
				Max	Min	A/IA	No. of mon. days (n)	Category of ES	
Chhattisgarh	Bhilai	Visak Hostel, Sector-4 R.O., 5/32 Banglow Office Building M.P Laghu Udyog Nigam	65 RIRuO 67 RIRuO 245 RIRuO	91 A 8 12 89 A 3 7 87 A 9 14	10 5 4 5 6 12 14	12 10 5 6 12 14	- 1 - 1 - 1	0 0 0 0 0 0	L L
	Bilaspur	RO, CECB Vyapar Vihar HIG 21/22.Near Ghantaghari, Pragati Nagar NTPC Colony	364 RIRuO 249 RIRuO 407 RIRuO	94 A 12 14 97 A 10 13 95 A 11 15	13 12 13 12 13 12	14 13 13 12 13 12	- 1 - 0 - 1	0 0 0 0 0 0	L L
	Korba	I.T.I., Rampur New HIG-9, Hirapur M/S Wool Worth India, Sarora Raipur	368 RIRuO 223 RIRuO 447 RIRuO	41 IA 11 17 46 IA 13 21 44 IA 8 17	14 11 16 14 12 14	15 11 19 16 7 7	2 0 2 0 8 -	0 0 0 0 0 0	L L
	Raipur	Yatayat Thana, Jai Stambh Chowk							-
	Dadra & Nagar Haveli	Silvassa	Khadoli Industrial Area, Village- Khadoli	558 RIRuO	94 A 7 8	7 7	8 -	0 0	L
	Daman & Diu	Daman	Kadaiya Industrial Area, Village- Kadaiya N.Y. School, Sarojini Nagar Town Hall, Chandni Chowk	560 RIRuO 144 RIRuO 146 RIRuO	96 A 7 8 96 A 2 18 96 A 2 23	7 4 2 4 7 2	8 3 2 3 5 14	0 0 0 0 5 0	L L
	Delhi	Delhi	Mayapuri Industrial Area Pritampura Shahadra Shahzada Bagh Nizamuddin Janakpuri Siri Fort	345 RIRuO 531 RIRuO 58 RIRuO 57 RIRuO 55 RIRuO 59 RIRuO 60 RIRuO	96 A 2 28 81 A 4 6 80 A 4 9 79 A 4 10 80 A 4 5 76 A 4 9 80 A 4 6	10 3 4 4 5 4 5 4 5 4 5 4 5 4	19 9 4 4 5 5 5 4 5 4 5 5 4 4	7 0 0 0 - 0 - 0 - 0 - 0 - 0	L L
			Panaji	327 RIRuO	105 A 2 35	4 2	2 2	5 0	L
			Marmagao	435 RIRuO	118 A 7 253	32 12	15 67	35 6	N
			Vasco	37 RIRuO	103 A 2 45	6 2	2 12	7 0	L
			Curchorem	628 RIRuO	19 IA 5 76	32 6	19 66	25 0	-
			Codli	630 RIRuO	6 IA 8 12	10 8	10 11	2 0	-
			Goa	631 ES	Sahyadri	8 IA 6 11	8 7	10 2	-
	Bicholim	632 RIRuO	11 IA 7 10	9 7	10 1	0 0	-	-	
	Amona	633 RIRuO	16 IA 4 9	6 5	9 6	2 0	-	-	
	Assanora	634 RIRuO	8 IA 4 7	5 4	7 5	1 0	-	-	
	Usgao	629 RIRuO	10 IA 2 10	6 3	5 5	3 0	-	-	

State	City	Location	Type	Air Quality														
				% exceedence (24 hourly)			Std. Dev.		90 percentile									
90 percentile			50 percentile			10 percentile			SO <sub>2</sub> Annual average (µg/m <sup>3</sup> )									
Max			Min			A/IA			No. of mon. days (n)									
Category of ES				Category of ES														
Station code		Type		Category of ES														
Gujarat	Ahmedabad	Naroda, G.I.D.C., Ahmedabad	101	RIRuO	104	A	12	23	20	18	20	22	2	0	L			
		Cadilla Bridge Narol	102	RIRuO	103	A	11	21	16	12	16	20	3	0	L			
		L.D. Engg. College	103	RIRuO	104	A	8	17	12	10	12	14	2	0	L			
		Shardaben Hospital, Saraspur	154	RIRuO	103	A	10	18	14	11	14	17	2	0	L			
		R.C. High School, Mirzapur	155	RIRuO	104	A	10	21	15	13	15	18	2	0	L			
	Anklesvar	Naroda, G.I.D.C.,	347	RIRuO	104	A	9	19	15	13	15	18	2	0	L			
		Rallis India Ltd.	252	RIRuO	104	A	12	24	18	14	18	23	4	0	L			
		Durga Traders, Bhavanafarm Society	253	RIRuO	104	A	10	19	15	12	14	18	3	0	L			
		Fisheries Office	319	RIRuO	104	A	9	26	12	10	12	15	2	0	L			
		Sardhara Industrial Corporation	257	RIRuO	104	A	8	19	13	12	13	15	2	0	L			
Haryana	Jamnagar	Regional Office	374	RIRuO	104	A	9	23	12	10	12	13	2	0	L			
		S.V.R. Engg. College	21	RIRuO	104	A	9	17	13	11	13	16	2	0	L			
		B.R.C. High School, Udhna	22	RIRuO	114	A	13	27	20	15	20	24	3	0	L			
		Air India Office	23	RIRuO	104	A	12	40	16	13	16	18	3	0	L			
		GPCB Office, Geri Vasahat	50	RIRuO	96	A	8	17	11	8	10	13	2	0	L			
	Vadodara	Dandia Bazaar	333	RIRuO	96	A	12	26	16	13	15	21	3	0	L			
		CETP Nandesar	334	RIRuO	96	A	17	31	23	20	23	26	3	0	L			
		GEB, IIrd Phase, GIDC, Vapi	367	RIRuO	104	A	11	49	17	13	17	19	6	0	L			
		Vapi Nagar Palika, Vapi	221	RIRuO	104	A	10	17	14	12	14	17	2	0	L			
		Escorts Research Centre Mathura Road	331	RIRuO	145	A	7	32	17	12	16	23	4	0	L			
Haryana	Hissar	RO Haryana SPCB	330	RIRuO	96	A	10	29	18	14	17	26	5	0	L			
		Urban Estate - II	390	RIRuO	27	IA	5	11	8	7	8	9	1	0	-			
		Guru Jambehswar University	414	RIRuO	52	A	2	18	7	2	6	16	4	0	L			
		Yamunanagar Ballarpur Industries	196	RIRuO	52	A	7	19	12	9	12	16	3	0	L			

State		City	Location	Type	Station code	Category of ES	No. of mon. days (n)	AIA	Min	Max	SO <sub>2</sub> Annual average (µg/m <sup>3</sup> )	10 percentile	50 percentile	90 percentile	Std. Dev.	% exceedence (24 hourly)	Air Quality
Baddi		Industry Department Office Building AHC Barotiwala	449 RIRuO		93 A 0 7 3 2 3 5 1 0 L												
Damtal		Housing Board Regional Office Old Road	564 RIRuO 563 RIRuO		77 A 1 9 3 2 3 5 1 0 L 10 IA 2 2 2 2 - 0 -												
Kala Amb		Kala Amb Industrial Area Trilokpur	268 RIRuO 271 RIRuO		147 A 2 2 2 2 2 2 - 0 L 113 A 2 2 2 2 2 2 - 0 L												
Nalagarh		Municipal Council Regional Office, Sector- 4	461 RIRuO 530 RIRuO		156 A 2 10 4 2 4 6 2 0 L 155 A 2 5 2 2 2 3 - 0 L												
Parwanoo		Asst. Commissioner Building, Sector I Paonta Sahib	565 RIRuO 132 RIRuO		66 A 1 8 3 2 3 4 1 0 L 147 A 2 5 3 2 2 3 - 0 L												
		Gondhpur Industrial Area	339 RIRuO		134 A 2 6 3 2 3 4 1 0 L												
		Tekka Bench Ridge	117 RIRuO		136 A 2 4 2 2 2 3 - 0 L												
Shimla		Bus Stand, Winterfield Regional Office, Jammu	118 RIRuO 34 ES	Hill station	107 A 2 5 3 2 3 4 1 0 L												
Jammu & Kashmir	Jammu	M.A. Stadium, Jewel Chowk, Jammu Bari Brahamana Industrial Area, Jammu	482 RIRuO 507 RIRuO		140 A 2 6 3 2 2 4 1 0 L												
		R.O. Dhanbad	612 RIRuO		114 A 2 8 4 2 3 6 1 0 L												
Jharkhand		CGM Office, Kusunda R.O. Dhanbad	611 RIRuO 44 RIRuO		67 A 12 36 16 13 15 18 3 0 L												
		Bistupur Vehical Testing Centre Golmuri Vehicle Testing Centre	351 RIRuO		77 A 12 36 16 13 14 20 4 0 L												
		Jharia M.A.D.A.	382 RIRuO		75 A 10 31 14 11 13 18 4 0 L												
		Ranchi Albert Ekka Chowk, Main Road	402 RIRuO		89 A 30 41 36 33 36 38 - 0 M												
		Saraikele Khar-sawan RO Building, Adityapur	91 RIRuO		111 A 16 31 19 17 14 17 20 3 0 L												
		Sindri BT / PDIL	332 RIRuO		68 A 13 36 17 14 17 20 3 0 L												
		West Singhbhum Barajamda U.M. Office	614 RIRuO		86 A 28 41 35 31 35 39 3 0 M												
			46 RIRuO		33 IA 11 24 16 12 15 21 3 0 -												
			615 RIRuO		84 A 15 36 21 18 20 24 3 0 L												



State	City	Location	Type	Station code	Air Quality								
					% exceedence (24 hourly)		Std. Dev.		90 percentile		50 percentile		
Max		Min		A/IA		No. of mon. days (n)		Category of ES		SO <sub>2</sub> Annual average (µg/m3)			
Bhopal		Hamidia Road, M.P. Harshilip Vikas Nigam C E T P Govindpura	RIRuO	I22	A	2	93	10	3	8	13	12	
Dewas	EID Perry (I) Limited Dewas Metal Section	RIRuO	RIRuO	I23	A	0	61	7	3	5	13	8	
Gwalior	Vikas Nagar Dindayal Nagar	RIRuO	RIRuO	I25	A	29	8	14	0	11	13	19	
Indore	Maharaj Bada Polo Ground Kothari Market, M.G. Road Telephone Nagar, Kanadia Road	RIRuO	RIRuO	I24	A	15	6	10	7	10	13	2	
Jabalpur	Vijay Nagar B C Labour Club	RIRuO	RIRuO	I26	A	7	70	22	12	17	43	13	
Nagda	Grasim Kalyan Kendra	RIRuO	RIRuO	I28	A	2	22	11	5	12	16	4	
Sagar	Pt. Deendayal Nagar, Housing Board Colony Sub-divisional Office E/M LightMachinery Regional Office MPPCB	RIRuO	RIRuO	I31	A	0	22	8	5	8	12	3	
Satna	Jayan Township N.T.P.C., Vidyanagar Waidhan	RIRuO	RIRuO	I32	A	5	3	4	3	4	4	-	
Ujjain	District Office Regional Office Mahakal Temple	RIRuO	RIRuO	I33	A	4	2	3	2	3	4	-	

Madhya Pradesh

State	City	Location	Air Quality																
			% exceedence (24 hourly)			Std. Dev.			90 percentile			50 percentile			10 percentile				
SO <sub>2</sub> Annual average (µg/m3)			Max			Min			A/IA			No. of mon. days (n)			Category of ES				
Station code			Type																
Amravati	M/s Apurva Oil and Industries Pvt. Ltd Govt College of Engineering Raikamal Square	549 548 547	RIRUO RIRUO RIRUO	88 97 96	A A A	9 6 6	15 14 18	12 11 13	10 8 11	12 13 14	14 2 2	2 0 0	— — —	— — —					
Aurangabad	S.B.E.S. College Collector Office C.A.D.A. Office, Garkheda B.I.W.A Office Grampanchayat Ghughus	511 512 513 514 649	RIRUO RIRUO RIRUO RIRUO RIRUO	110 108 97 92 93	A A A A A	4 3 3 5 5	13 7 19 32 30	11 11 6 31 9	14 14 6 31 23	16 16 6 53 62	2 2 1 15	0 0 0 —	— — — —						
Badlapur	MIDC Chandrapur Nagar Parishad Gadhchandur Gram Panchayat, Rajura MIDC, Tadali	28I 396 640 638	RIRUO RIRUO RIRUO RIRUO	96 97 74 62	A A A A	5 5 4 5	18I 48 79 20	38 48 20 7	8 24 6 7	24 92 27 15	9 36 53 36	13 13 2 —	— — — —						
Chandrapur	Municipal Council, Ballarshah	639	RIRUO	69	A	4	85	20	6	15	35	14	—	—					
Jalgao	B.J. Market Girna water tank MIDC Jalaazon	644 645 646	RIRUO RIRUO RIRUO	69 68 70	A A A	9 9 15	9 9 28	19 19 21	16 16 16	22 22 20	4 4 25	2 0 3	— — —						
Kolhapur	University Campus, Shivaji University, Raikar Trust, Dahholkar Corner, ST Stand Mahadwar Road, Near Mahalaxmi Temple	508 509 510	ES ES ES	92 94 102	Sahyadri Sahyadri Sahyadri	15 10 10	32 24 16	20 16 13	16 16 16	19 20 20	38 35 36	12 14 13	— — —						
Latur	MIDC Water Works Terrace of Kshetrewari Vidyalaya Shyamnagar	64I 642	RIRUO RIRUO	96 104	A A	4 4	22 22	8 8	4 4	7 6	15 12	4 4	— —						
Lote	MIDC Chalkewadi Pump House, CETP	489 490	RIRUO RIRUO	12 18	I.A I.A	24 13	180 136	74 46	21 21	28 46	60 65	132 65	46 28	— 6					
Mahad	Water treatment plant, Bhirwadi EHS, M/s Privi organics Ltd Mahatma Phule Hall, MNP	569 570 571	RIRUO RIRUO RIRUO	66 56 50	A A A	9 11 10	36 21 26	19 21 16	12 12 16	18 21 16	26 27 22	6 6 4	0 0 —						
Mumbai	Kalbadevi Parel / Ambedkar Road Worli	169 170 349	RIRUO RIRUO RIRUO	169 170 103	A A A	2 2 2	35 35 16	4 4 4	2 2 2	3 3 3	6 4 3	4 4 8	0 0 —						
Nagpur	Institution of Engineers Govt. Polytechnic College, Sadar MIDC Office Hingana Road MIDC Industrial Area, MIDC Office, Hingna Masakasath, Iwari NEERI Lab, Nehru Marg R.T.O. Colony Tank	314 288 165 166 167 259 269	RIRUO RIRUO RIRUO RIRUO RIRUO RIRUO RIRUO	87 83 81 98 96 112 113	A A A A A A A	7 7 2 2 2 11 13	19 11 48 17 22 35 38	11 11 6 3 3 20 23	9 9 6 2 2 16 19	13 14 2 2 2 27 28	2 2 8 3 4 4	2 0 0 0 0 4 4	— — — — — — —						
Nashik	VIP Industrial Area, MIDC Satpura Nashik Municipal Council Building T.B.I.A, Rabale, Airoli, TTC Dr. D.Y. Patil College, Nerul, TTC MRBC Central Lab, Mhape	280 49I 492 493 494	RIRUO RIRUO RIRUO RIRUO RIRUO	101 102 104 105 105	A A A A A	1 1 1 8 6	31 63 7 49 43	21 23 11 22 15	21 21 11 22 13	26 26 16 27 13	4 4 5 5 0	— — — — —							
Navi Mumbai	CIDCO Nodal Office Kharghar Panvel Residential Area, Talaja MIDC Colom Facility Building	495 496	RIRUO RIRUO	99 99	A A	8 8	74 195	30 40	16 15	29 31	44 74	11 10	0 —						
Pune	Maratha Chamber of commerce, Bhosari State Electricity Board BLDG Naslstop Swargate Police Clawki	312 379 38I	RIRUO RIRUO RIRUO	104 104 104	A A A	10 10 10	45 49 49	23 23 21	13 13 13	31 31 21	28 38 37	10 9 9	0 0 0						

Maharashtra

State	City	Location	Air Quality		% exceedence (24 hourly)		Std. Dev.		90 percentile		50 percentile		10 percentile	
			Type	Station code										
Roha	Roha	Roha Industrial Association office Filter House of MIDC Water works	RIRuO	572	A	9	29	16	12	15	23	4	0	L
Sangli		Udyog bhavan / SRO, MPCB Sangli Sangli- Miraj Primary school Building	RIRuO	573	A	9	27	17	11	17	23	4	0	L
Solapur	Krishna Valley School WIT Campus	Voronoko School / Chitale Clinic	RIRuO	574	A	8	20	13	9	13	16	3	0	L
Thane		Maternity Hospital,Dhobighat,Kopri Terrace of Shahru Market,Naupada	RIRuO	575	RIRuO	105	A	8	20	13	9	15	4	0
Ulhasnagar	Kolshet and Balkun, Thane West Smt. C. H. M. College Campus	Octroi Naka	RIRuO	576	RIRuO	104	A	7	24	14	9	15	4	0
Tura		EPIP,Ri-Bhoi district Terrace building,Jaintia Hills District	RIRuO	577	RIRuO	104	A	8	24	14	10	14	20	0
Shillong		Office building of Add Chief Engineer, Garo Hills District	RIRuO	578	RIRuO	106	A	13	19	17	15	16	18	1
Aizawl		State Tuberculosis Hospital Boards Office Permisises, Lumpyngngad	RIRuO	579	RIRuO	107	A	13	20	17	15	17	19	1
Mizoram		Khatla, M.G-Road, Mizoram SPCB	RIRuO	580	RIRuO	108	A	10	20	16	14	16	19	2
Aizawl		Laipuitlang, Residence of Chairman, MPCB Bawngkawn , Roof Top of Mr.K.L. Berema's residence	RIRuO	581	RIRuO	109	A	4	85	30	15	26	47	1
Dimapur		Bank Colony Dhobiinala	RIRuO	582	RIRuO	104	A	2	2	2	2	2	2	-
Kohima		Opposite NST Office Opposite War Cemetery	RIRuO	583	RIRuO	104	A	2	2	2	2	2	2	-
Nagaland			RIRuO	584	RIRuO	104	A	2	2	2	2	2	2	-

State	City	Location	Air Quality									
			% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	SO <sub>2</sub> Annual average (µg/m <sup>3</sup> )	Max	Min	A/IA	No. of mon. days (n)
			Category of ES									
Station code	Type											
Angul	Industrial Estate NALCO Township	70 23 I	RIRUO RIRUO	103 100	A A	4 6	8 7	6 7	5 6	7 7	1 1	0 0
Balasore	Sahadevkhunta	428	RIRUO	100	A	2	2	2	2	2	-	0
Berhampur	Regional Office Orissa SPCB	429	RIRUO	95	A	2	2	2	2	2	-	0
Bhubneshwar	Capital Police Station IRC Village	424 423	RIRUO RIRUO	105 98	A A	2 2	2	2	2	2	-	0
Cuttack	SPCB Building Roof of Traffic Tower, Badambadi R.O. Cuttack Office, Surya Vihar	322 426 425	RIRUO RIRUO RIRUO	113 105 45	A A IA	2 2	2	2	2	2	-	0
Rayagada	Regional Office Orissa SPCB	428	RIRUO	103	A	2	3	2	2	2	-	0
Rourkela	LPS High School, Jaykaypur Regional Office, ORPB	229 370	RIRUO RIRUO	103 94	A A	2 4	2	2	2	2	-	0
Sambalpur	IDL Police Out-post, Sonaparbat Filter Plant, PHD Office, Modipara	227 427	RIRUO RIRUO	104 84	A A	4 2	7	5	4	5	6	1
Talcher	Coal Field Area / MCL AREA TTPS Colony	471 68	RIRUO RIRUO	66 103	A A	8 4	44	14	12	14	15	4
Amritsar	R.O. Focal Point, Amritsar A-I,Platers, Amritsar / VMC	487 486	RIRUO RIRUO	53 57	A A	12 11	18	14	13	14	16	1
Bhatinda	M/s Milk Plant, Ropar	506	RIRUO	96	A	5	18	9	7	9	12	2
Dera Bassi	M/s Punjab Chemicals & Crop Protection Ltd M/s Winsome Yarns Ltd., Barwala Road, Dera Bassi	504 505	RIRUO RIRUO	128 138	A A	6 5	18	10	8	10	14	3
Pathankot/ Gobindgarh	C-PYTE Building at Dera Baba Nanak M/s Modi Oil and General Mills M/s Raj Steel Rolling Mills	590 302 30 I	RIRUO RIRUO RIRUO	56 107 121	A A A	4 10 11	11	7	5	7	8	1
Jalandhar	United Rolling Mills, Mandi Gobindgarh Municipal Council Tubewell	483 353	RIRUO RIRUO	96 25	A IA	10 10	32	18	14	17	23	4
Khanna	Markfed Vanaspati, Khanna AS School, Khanna	485 484	RIRUO RIRUO	123 134	A A	5 5	17	9	7	9	12	2

State	City	Location	Air Quality		% exceedence (24 hourly)		Std. Dev.		90 percentile		50 percentile		10 percentile		SO <sub>2</sub> Annual average (µg/m <sup>3</sup> )	
			Max	Min	A/IA	No. of mon. days (n)	Category of ES	Type	Station code	Max	Min	A/IA	No. of mon. days (n)	Category of ES	Type	Station code
Ludhiana	Bharat Nagar Chowk	422	RIRuO	24	IA	7	10	9	7	9	1	0	-			
	Nahar Spining Mills, Dholewala Chowk	76	RIRuO	115	A	5	19	10	6	10	14	3	0	L		
	Milk plant, Ferozpur Road	61	RIRuO	131	A	5	14	9	6	9	11	2	0	L		
	Vishav karma Chowk	335	RIRuO	126	A	5	17	9	6	10	13	2	0	L		
	M/s Punjab Alkalies & Chemicals Ltd.	420	RIRuO	111	A	5	13	7	6	7	8	1	0	L		
	M/s NFL Guest House	421	RIRuO	104	A	5	9	7	6	6	8	1	0	L		
Patiala	Ceylon Industries	600	RIRuO	126	A	3	14	7	4	7	10	2	0	L		
	Fire Brigade Station, Bahera Road,	599	RIRuO	119	A	4	12	6	5	6	8	1	0	L		
	DSTC Office Upstairs, Anna Nagar	64	RIRuO	90	A	3	9	6	4	6	8	1	0	L		
	PIP DIC Ind. Estate Mettupalyam	93	RIRuO	82	A	4	10	6	4	7	8	2	0	L		
Puducherry	PIP DIC Ind. Estate Mettupalyam	337	RIRuO	83	A	2	9	5	3	5	8	2	0	L		
	Chamber Of Commerce	372	ES	Aravali range		79	A	4	14	7	4	7	9	2	0	L
	Regional Office, Rajasthan SPCB	373	ES	Aravali range		75	A	4	24	9	4	8	14	4	0	L
	Gaurav Solvex Ltd. MIA	219	ES	Aravali range		72	A	4	24	8	4	7	13	4	0	L
	RICO Pump House, MIA	296	RIRuO	1	IA	5	37	6	5	6	6	3	0	-		
	Ajmeri Gate	298	RIRuO	110	A	2	6	5	5	5	6	1	0	L		
Jaipur	RJPB Office, Jhalana Doongari	408	RIRuO	94	A	4	10	6	5	6	7	1	0	L		
	Office of District Education Officer, Chandpole	410	RIRuO	102	A	4	7	6	5	5	6	-	0	L		
	RICO Office, M.I.A.	409	RIRuO	109	A	5	11	6	5	6	7	1	0	L		
	Regional Office (North), RSPCB, Vidyadhar Nagar	297	RIRuO	114	A	5	11	6	5	6	7	1	0	L		
	VKA	413	RIRuO	96	A	4	12	6	5	6	7	1	0	L		
	DIC Office, Industrial Estate	273	RIRuO	103	A	4	15	6	5	6	7	1	0	L		
Jodhpur	Sojati Gate	274	RIRuO	97	A	3	25	7	5	6	8	3	0	L		
	Basni Industrial Area, RICO Office	376	RIRuO	99	A	4	11	5	5	5	5	1	0	L		
	Maha Mandir Police Thane	411	RIRuO	98	A	4	15	5	5	5	5	1	0	L		
	Office of Housing Board, Chopasani Road	412	RIRuO	102	A	4	12	6	5	6	6	1	0	L		
	Shastri Nagar Police Thana	17	RIRuO	102	A	9	20	13	10	13	15	2	0	L		
	Regional Office, RJPB, Anantpura	326	RIRuO	101	A	7	16	12	9	12	14	2	0	L		
Kota	Municipal Corporation Building	325	RIRuO	103	A	5	20	6	5	6	8	2	0	L		
	Samcore Glass Ltd.	320	RIRuO	92	A	4	7	5	5	6	1	0	L			
	Ambamata	294	RIRuO	96	A	4	7	6	5	6	7	1	0	L		
Udaipur	Town Hall	321	RIRuO	86	A	5	128	7	5	6	7	13	1	L		
	Regional Office, MIA															

Rajasthan

State	City	Location	Air Quality		% exceedence (24 hourly)		Std. Dev.		90 percentile		50 percentile		10 percentile		
			<b>SO<sub>2</sub> Annual average (µg/m<sup>3</sup>)</b>		<b>Max</b>		<b>Min</b>		<b>A/IA</b>		<b>No. of mon. days (n)</b>				
Tamilnadu	Chennai	Kathivakkam, Municipal Kalyana Mandapam	38	RIRuO	100	A	9	17	11	9	11	14	2	0	L
		Govt. High School, Manali	71	RIRuO	102	A	9	16	11	9	11	14	2	0	L
		Thiruvottiyur	72	RIRuO	93	A	9	26	13	10	12	15	2	0	L
		Madras Medical College	159	RIRuO	93	A	2	25	6	2	6	11	4	0	L
		NEERI, CSIR Campus	160	RIRuO	95	A	2	20	5	2	4	8	3	0	L
	Coimbatore	Thiruvottiyur Municipal Office	161	RIRuO	94	A	2	22	6	3	5	11	4	0	L
		Poniarajapuram, On the top of DEL	371	RIRuO	50	A	4	8	5	4	4	6	1	0	L
		G.D.Matric Hr.Sec.School	238	RIRuO	93	A	4	49	5	4	4	7	5	0	L
	Madurai	SIDCO Office Kurichi	237	RIRuO	85	A	4	43	6	4	4	6	7	0	L
		Highway (Project -I) Building	306	RIRuO	102	A	6	16	10	8	10	13	2	0	L
		Fenner (I) Ltd. Susee Cars & Trucks	307	RIRuO	92	A	7	19	11	8	11	14	2	0	L
	Salem	Kunnathur Chatram Girls HS School	308	RIRuO	94	A	7	15	11	8	11	13	2	0	L
		Sowdeswari College Building	309	RIRuO	96	A	6	12	8	7	8	10	1	0	L
		Fisheries College	239	RIRuO	98	A	4	36	13	6	11	19	6	0	L
	Tuticorin	Raja Agencies	240	RIRuO	86	A	4	56	11	5	10	17	7	0	L
		Regional Office, Bodla	323	ES	Taj-trapezium	80	A	7	12	9	1	8	9	11	O
		Nunhai	324	ES	Taj-trapezium	79	A	7	13	10	1	8	10	11	O
Uttar Pradesh	Agra	Taj Mahal	1	ES	Taj-trapezium	286	A	2	18	3	2	2	7	3	O
		DIC Nunhai	415	ES	Taj-trapezium	131	A	2	18	4	2	2	7	3	O
		Ertmad-uddaulah	416	ES	Taj-trapezium	123	A	2	11	3	2	2	6	2	M
	Ferozabad	Rambagh	417	ES	Taj-trapezium	116	A	2	20	3	2	2	5	2	M
		Square crossing circle of Laxmi Talkies	554	RIRuO	105	A	2	29	5	3	2	3	8	0	L
Uttar Pradesh	Anpara	Allahabad	555	RIRuO	105	A	1	40	4	4	2	3	7	0	L
		Bharat Yantra Nigam Ltd	6	RIRuO	104	A	13	20	17	1	16	17	18	0	L
		Anpara Colony, Sonabhadra	7	RIRuO	87	A	11	19	17	1	16	17	18	0	L
	Ferozabad	Center for Development of Glass Industry ( CDGI )	399	ES	Taj-trapezium	104	A	8	32	17	5	10	18	23	O
		Tilak Nagar	400	ES	Taj-trapezium	103	A	7	24	16	5	9	16	22	O
	Raza ka Tal	401	ES	Taj-trapezium	101	A	7	25	15	6	8	16	21	O	M

State	City	Location	Air Quality		% exceedence (24 hourly)								
			Std. Dev.										
		<b>90 percentile</b>											
		<b>50 percentile</b>											
		<b>10 percentile</b>											
		<b>SO<sub>2</sub> Annual average (µg/m<sup>3</sup>)</b>											
		<b>Max</b>											
		<b>Min</b>											
		<b>A/IA</b>											
		<b>No. of mon. days (n)</b>											
			<b>Category of ES</b>										
			<b>Type</b>										
			<b>Station code</b>										

State	City	Location	Type	Category of ES	Air Quality			
					% exceedence (24 hourly)	Std. Dev.		
Uttarakhand				<b>90 percentile</b>		-		
		<b>50 percentile</b>		<b>10 percentile</b>		-		
		<b>SO<sub>2</sub> Annual average (µg/m<sup>3</sup>)</b>				-		
		<b>Max</b>				-		
		<b>Min</b>				-		
		<b>A/IA</b>				-		
		<b>No. of mon. days (n)</b>				-		
Dehradun	Raipur Road, Near parag Diary	90	ES	Doon valley	18	IA		
	Clock Tower, PWD Guest House	89	ES	Doon valley	32	IA		
	Himalaya Drug Co, Near ISBT	637	ES	Doon valley	-	-		
	Govt. Women Hospital	625	RIRuO	-	-	-		
	SIDCUL, Haridwar	635	RIRuO	-	-	-		
	BSNL Office, Kashipur	627	RIRuO	-	-	-		
	Nagar Palika Parishad	636	ES	Hill station	-	-		
	Asansol Municipal Corporation	386	RIRuO	105	A	5		
	Kangsabati Spinning Mill, Barjora	593	RIRuO	105	A	5		
	Burnpur Town Department, Burnpur	592	RIRuO	105	A	4		
Rishikesh	Barrackpore Municipality	655	RIRuO	102	A	5		
	Dum Dum Telephone Exchange	653	RIRuO	101	A	6		
	Khardah Municipality	654	RIRuO	102	A	7		
	DMC Water Works, Angadpur	591	RIRuO	105	A	5		
	Kwality Hotel, Bhiringi More, Benachiti	384	RIRuO	105	A	6		
	Bidhannagar, PCBL Club, Muchipara	385	RIRuO	105	A	5		
	Dew India Limited, PCBL More, Durgapur	383	RIRuO	105	A	6		
	Bhabanipur, Debhog Milan Viyapith	663	RIRuO	108	A	10		
	Driver's Hut of M/s. MCC PTA, Bhunia Raichak	664	RIRuO	108	A	9		
	Supermarket Building, Durgachak	15	RIRuO	108	A	8		
Howrah	WBIDC Durgachak	14	RIRuO	108	A	10		
	Howrah Municipal Corporation Building	8	RIRuO	103	A	6		
	Naskarpura Pump House, Ghuseri	10	RIRuO	103	A	6		
	CDS & Health Centre, Bator	11	RIRuO	103	A	5		
	Howrah Municipality School, Bandhaghata	9	RIRuO	103	A	7		
						27		
						5		

State	City	Location	Air Quality										
			% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	SO <sub>2</sub> Annual average ( $\mu\text{g}/\text{m}^3$ )	Max	Min	A/IA	No. of mon. days (n)	Category of ES
			Station code	Type									
Kolkata		Salt Lake, Rooftop of CK Market	474	RIRuO	103	A	4	17	8	5	7	11	3
		Moullali, Rooftop of KMC office Building	473	RIRuO	104	A	5	19	9	6	9	14	3
		Minto Park, Inside Park AJC Bose Road	475	RIRuO	102	A	4	14	8	5	7	11	2
		Dunlop Bridge, National Sample Survey Building	472	RIRuO	102	A	4	15	8	6	8	12	3
		Behala Chowrasta, Traffic Guard Building	476	RIRuO	103	A	4	20	9	5	8	13	3
		Baishnabghata, Upanagar Sporting Club	477	RIRuO	101	A	4	11	6	4	6	9	2
		Cossipore Police Station, B.T. Road	162	RIRuO	96	A	2	132	22	2	18	43	21
		Lal-Bazar, Dalhousie Square	163	RIRuO	96	A	2	107	16	2	13	29	15
		Kasba	348	RIRuO	96	A	2	106	14	2	12	26	14
		Raniganj Municipality	662	RIRuO	105	A	6	13	9	7	9	11	1
Raniganj		Mangalpur, SKS School Mangalpur	660	RIRuO	105	A	5	10	8	7	8	9	1
		Jamuria Municipality	661	RIRuO	105	A	6	11	8	7	8	10	1
		Bharat Co-operative Housing Society	657	RIRuO	104	A	5	19	9	6	9	13	3
		Bagan Police Station, Bagan	659	RIRuO	104	A	5	27	12	7	11	20	5
		Dhullagar Gram Pachayat	656	RIRuO	104	A	5	22	11	7	11	18	4
Sankrail		P Mukherjee's House, Near SBI Amta	658	RIRuO	104	A	4	14	7	5	6	8	2
		Chanditala Water Supply Pump House, Tol-lyunge	652	RIRuO	102	A	4	13	7	5	7	11	3
		Baupur Police Station, Baupur	650	RIRuO	105	A	4	11	6	4	6	9	2
		P Roy Industrial Training Institute, Amtala	651	RIRuO	103	A	4	13	7	4	7	10	2
		South Suburban											

West Bengal

Note: \* - Locations where annual mean concentration of SO<sub>2</sub> exceeded the NAAQS of 50  $\mu\text{g}/\text{m}^3$  for Residential/ industrial / other area and 20  $\mu\text{g}/\text{m}^3$  for sensitive area. : ' Data not available/outlier/ not classified as monitoring days <50days, RIRuO – Residential/industrial/other area, ES – Ecologically sensitive area, Std dev. – Standard deviation, Mon - monitoring, n – number of days monitored for 16 and more hours a day L- Low, M- Moderate, H – High and C – Critical levels of pollution based on exceedence factor (calculated for n ≥ 50 days) classification based on Pollution Level Classification, Chapter 2, Table 2. , % violation – percentage violation of NAAQS (24 hourly average) BDL = Below Detection Limit (Concentration less than 4  $\mu\text{g}/\text{m}^3$  for SO<sub>2</sub>).

Oxides of nitrogen are a generic term for a group of highly reactive gases that contain nitrogen and oxygen in varying amounts. Oxides of nitrogen are formed during combustion processes at high temperatures from the oxidation of nitrogen in air. NOx are emitted as nitrogen oxide (NO) which is rapidly oxidized to nitrogen dioxide (NO<sub>2</sub>). Nitrogen dioxide (NO<sub>2</sub>) is a reddish-brown toxic gas with a characteristic sharp, biting odor and is a prominent air pollutant. Sources of nitrogen oxides includes lightning, forest fires, bacterial activity of soil as natural source and vehicles, industrial processes that burn, high temperature combustion (internal combustion engines, fossil fuel-fired power stations, industrial, burning of bio-mass and fossil fuels are anthropogenic sources. NO<sub>2</sub> irritates the nose and throat increase susceptibility to respiratory infections. In addition, NOx is a potent and selective vasodilator in pulmonary arterial hypertension. Oxides of nitrogen react with Volatile Organic Compounds (VOCs) to form ground level ozone. They also react to form nitrates, acid aerosols. Almost all NOx is emitted as NO, which is rapidly oxidized to non toxic NO<sub>2</sub>.

In this chapter the a detailed summary of NO<sub>2</sub> levels in the country is furnished. The air quality of different cities/towns has been compared with the respective NAAQS. The air quality has been categorized into four broad categories based on an Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard. The four categories are low, moderate, high and critical levels. The top 10 location, cities and states with maximum NO<sub>2</sub> pollution is given.

#### 4.1 Locations, cities and states with highest NO<sub>2</sub> values during 2010

Table 4.1 shows top ten locations in terms of annual average concentration of NO<sub>2</sub> for residential / industrial / rural / other area in which highest concentration was observed at monitoring station located at Bandhabghat, Howrah, West Bengal. In sensitive area highest concentration was observed at CDGI, Ferozabad, Uttar Pradesh (Table 4.2). Among the cities Howrah, West Bengal tops the list with 75 µg/m<sup>3</sup> NO<sub>2</sub> (Table 4.3). Among the states West Bengal shows highest NO<sub>2</sub> values 64 µg/m<sup>3</sup> (Table 4.4)

**Table 4.1: Ten locations with higher NO<sub>2</sub> values (annual average) during 2010  
(residential / industrial / rural / other area)**

Sl. No.	State	City	Location	Station code	No. of mon. days (n)	Min	Max	Annual average (µg/m <sup>3</sup> )	Std. Dev.	% exceedence (24 hourly)	Air Quality
1	West Bengal	Howrah	Howrah Municipality School, Bandhaghat	9	103	40	169	84.74*	30	50	C
2	West Bengal	Barrackpore	Khardah Municipality	654	102	42	156	80.47*	28	39	C
3	West Bengal	Howrah	Howrah MC Building	8	103	43	161	79.63*	27	38	C
4	Delhi	Delhi	Town Hall, Chandni Chowk	146	96	38	125	75.79*	19	40	C
5	West Bengal	Barrackpore	DumDum Telephone Exchange	653	101	40	146	75.72*	26	32	C
6	West Bengal	Sankrail	Bagan Police Station, Bagan	659	104	30	154	75.52*	30	30	C
7	West Bengal	Kolkata	Moulali, KMC office	473	104	38	160	74.82*	28	37	C
8	West Bengal	Sankrail	Dhulagar Gram Pachayat	656	104	30	137	74.07*	26	27	C
9	West Bengal	Howrah	Naskarpara Pump House, Ghuseri	10	103	37	141	73.50*	25	33	C
10	Maharashtra	Ulhasnagar	Oktroi Naka	648	94	8	197	73.46*	37	38	C

\* - Locations where annual mean concentration of NO<sub>2</sub> exceeded the NAAQS of 40 µg/m<sup>3</sup> for Residential/ industrial / other area. Std. dev:standard deviation, mon:monitoring, n:number of monitoring days; L:Low, M:moderate, H:high, C:critical classification based on Pollution Level Classification, Chapter 2, Table 2, Data of monitoring stations with monitoring days ≥50 has only been considered

**Table 4.2: Ten locations with highest NO<sub>2</sub> values (annual average) during 2010 (Ecologically sensitive area)**

Sl. No.	State	City	Location	Station code	ESA category	No. of mon. days (n)	Min	Max	Annual average ( $\mu\text{g}/\text{m}^3$ )	Std. Dev.	% exceedence (24 hourly)	Air Quality
1	Uttar Pradesh	Ferozabad	CDGI	399	Taj-trapezium	104	23	42	35*	40	0	H
2	Uttar Pradesh	Agra	DIC Nunhai	415	Taj-trapezium	131	5	67	33*	13	0	H
3	Uttar Pradesh	Ferozabad	Tilak Nagar	400	Taj-trapezium	103	23	43	33*	38	0	H
4	Uttar Pradesh	Ferozabad	Raza ka Tal	401	Taj-trapezium	101	21	59	32*	36	0	H
5	Maharashtra	Kolhapur	Ruikar Trust, Dabholkar Corner	509	Sahyadri	92	16	37	26	5	0	M
6	Rajasthan	Alwar	Gaurav Solvex Ltd. MIA	373	Aravali range	75	8	58	26	11	0	M
7	Rajasthan	Alwar	RO, Rajasthan SPCB	372	Aravali range	79	12	51	26	9	0	M
8	Uttar Pradesh	Agra	Rambagh	417	Taj-trapezium	117	5	55	24	11	0	M
9	Uttar Pradesh	Agra	Etmad-uddaulah	416	Taj-trapezium	123	5	53	22	11	0	M
10	Rajasthan	Alwar	RIICO Pump House, MIA	219	Aravali range	72	6	53	21	8	0	M

\* - Locations where annual mean concentration of NO<sub>2</sub> exceeded the NAAQS of 30  $\mu\text{g}/\text{m}^3$  for sensitive areas. Std.dev:standard deviation, mon:monitoring, n:number of monitoring days; L:Low, M:moderate, H:high, C:critical classification based on Pollution Level Classification, Chapter 2, Table 2.1, Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

**Table 4.3: Ten cities with highest NO<sub>2</sub> values (annual average) during 2010 (residential / industrial / rural / other area)**

Sl. No.	State	City	Min	Max	Annual average ( $\mu\text{g}/\text{m}^3$ )	Std. Dev.	Air Quality
1	West Bengal	Howrah	37	147	75*	25	C
2	West Bengal	Barrackpore	39	140	74*	24	C
3	Maharashtra	Badlapur	9	175	73*	37	C
4	Maharashtra	Ulhasnagar	8	162	68*	33	C
5	West Bengal	Durgapur	42	91	66*	11	C
6	West Bengal	Asansol	46	88	66*	10	C
7	West Bengal	Sankrail	28	120	65*	22	C
8	West Bengal	Raniganj	45	85	63*	10	C
9	West Bengal	Kolkata	23	142	62*	27	C
10	West Bengal	South Suburban	25	113	56*	23	C

\* - Cities where annual mean concentration of NO<sub>2</sub> exceeded the NAAQS of 40  $\mu\text{g}/\text{m}^3$  for Residential/industrial / other area. L: Low, M:moderate, H:high, classification based on Pollution Level Classification, Chapter 2, Table 2.1 Data of Monitoring Stations with Monitoring days  $\geq 50$  has only been considered.

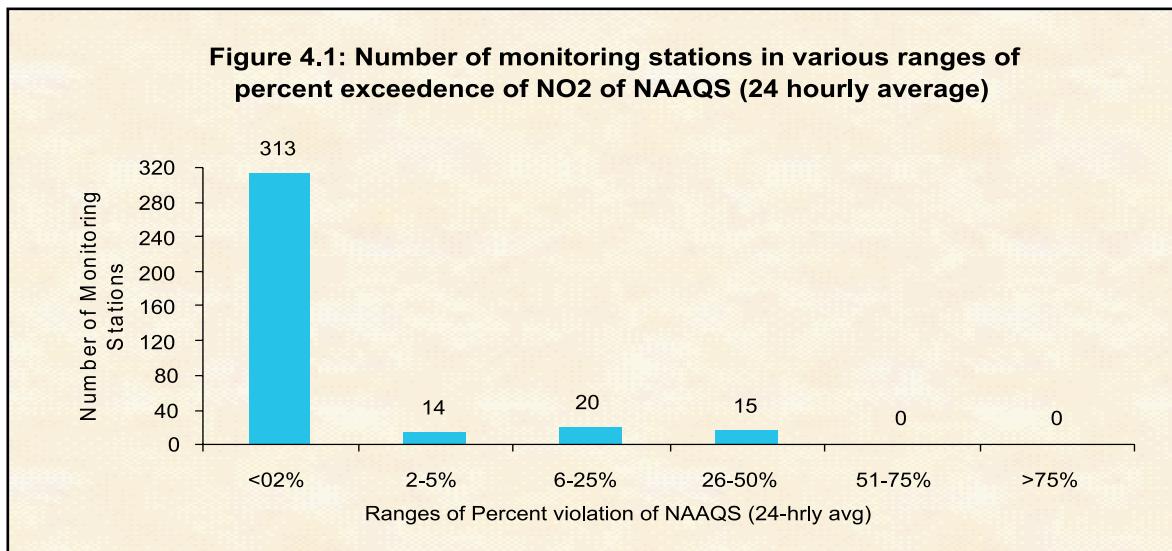
**Table 4.4: Ten state with highest NO<sub>2</sub> values (annual average) during 2010 (residential / industrial / rural / other & ecologically sensitive area)**

Sl. No.	State	Min	Max	Annual average ( $\mu\text{g}/\text{m}^3$ )
1	West Bengal	34	115	64*
2	Delhi	26	83	55*
3	Jharkhand	28	52	39
4	Maharashtra	15	70	31
5	Uttar Pradesh	20	42	30
6	Rajasthan	18	49	29
7	Punjab	18	42	27
8	Bihar	11	57	26
9	Gujarat	16	37	23.1
10	Haryana	16	41	22.9

\* - Locations where annual mean concentration of NO<sub>2</sub> exceeded the NAAQS of 40  $\mu\text{g}/\text{m}^3$  for Residential/ industrial / other area. , Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

## 4.2 Percentage exceedence of NAAQS (24 Hourly Average)

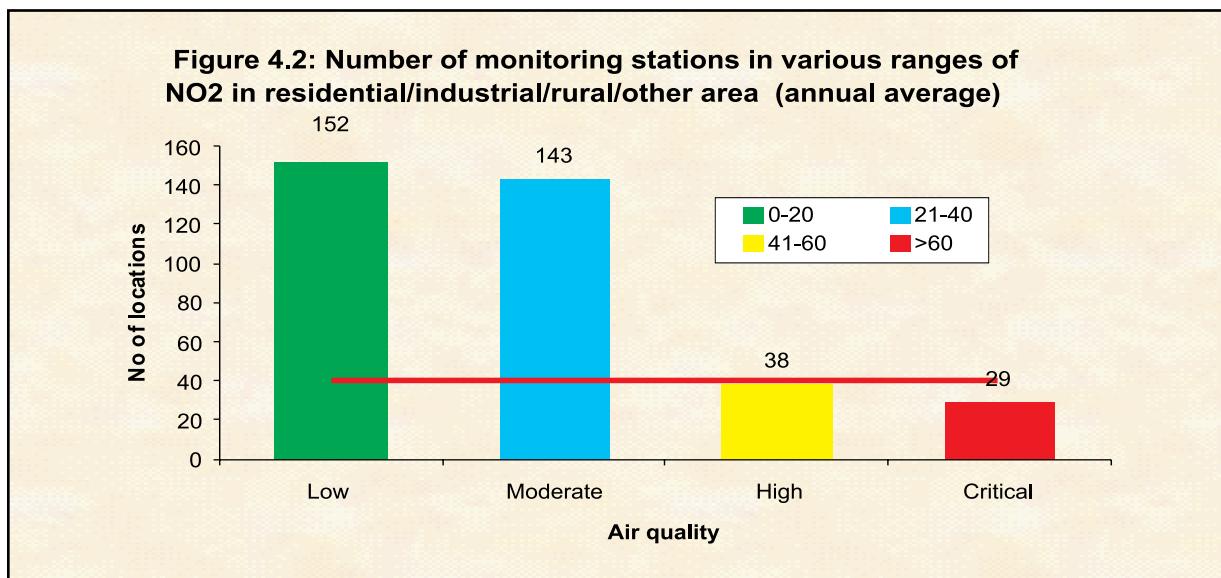
Number of monitoring stations in various ranges of percentage exceedence of NAAQS (24 hourly average) of  $\text{NO}_2$  is depicted in Figure 4.1. The percentage exceedence of NAAQS (24 hourly Average) was less than 2% at 313 monitoring stations out of 362 stations. In the remaining 49 stations, the percentage exceedence of NAAQS (24 hourly avg.) was 2% or more.



NB. Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

## 4.3 Air Quality (Low, Moderate, High & Critical)

Number of monitoring stations with low, moderate, high and critical levels of  $\text{NO}_2$  is depicted in Figure 4.2. 152 locations showed low  $\text{NO}_2$  level, 143 locations showed moderate, 38 high and 29 location were in critical category. Therefore, 67 (19%) locations out of 362 exceeded the NAAQS.



NB. Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

The annual average concentration of  $\text{NO}_2$  at various monitoring stations is given in Table 4.5. The data given is annual average concentration and number of observations with 16 and more hours of monitoring a day. Also, described in the table is air quality in terms of low, moderate, high and critical.  $\text{NO}_2$  levels at many monitoring stations (with high and critical air quality) exceeded the prescribed limit.

**Table 4.5: NO<sub>2</sub> levels (Annual average) in Ambient Air Quality Stations under NAMP during 2010**

State	City	Location	Type	Station code	Air Quality		% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	NO <sub>2</sub> Annual average (µg/m <sup>3</sup> )
					Max	Min						
	Chittoor	GNC Toll Gate Tirumala	RIRuO	582	93	A	9	9	9	9	-	0
	Guntur	Near Hindu College, Market Road	RIRuO	583	102	A	9	15	11	11	12	1
	Tarnaka, NEERI Lab.		RIRuO	150	94	A	6	45	20	15	25	5
	Nacharam, Industrial Estate		RIRuO	151	89	A	5	43	18	13	17	23
	ABIDS Circle General Post Office Building		RIRuO	152	92	A	12	47	26	18	26	35
Hyderabad	Balanagar		RIRuO	95	108	A	22	71	29	25	29	35
	Uppal, IDA		RIRuO	203	108	A	15	52	29	25	28	34
	Jubilee Hills		RIRuO	365	108	A	14	29	17	15	16	18
	Paradise		RIRuO	393	108	A	24	59	30	25	29	35
	Charminar		RIRuO	394	108	A	22	55	29	25	29	34
	Zoo Park		RIRuO	470	107	A	14	46	17	15	16	17
	Kothagudem	CER Club, Khamam	RIRuO	581	103	A	10	13	11	10	11	12
	Kurnool	Mourya Inn	RIRuO	466	118	A	9	9	9	9	9	-
	Nalgonda	RO, APPCB	RIRuO	577	108	A	19	29	23	20	24	27
	Nellore	Kamakhya Temple	RIRuO	580	94	A	10	13	12	11	12	1
	Patencheru	Police Station, Ramachandrapuram	RIRuO	468	98	A	18	33	23	20	23	26
	Ramagundam	Karimnagar Godavarikhani	RIRuO	465	98	A	5	50	12	5	9	24
	Tirupati	Regional Science Centre, Chittoor Bypass Road	RIRuO	389	104	A	9	9	9	9	9	-
	Vijaywada	Benz Circle	RIRuO	462	113	A	8	15	12	10	13	14
	Warangal	Autonagar	RIRuO	469	113	A	10	20	15	12	15	19
		KUDA Office, Hanumakonda	RIRuO	579	102	A	5	32	10	5	8	16
Vishakhapatnam	Panchayat Raj office, Mindi		RIRuO	234	108	A	9	155	18	10	17	26
	Industrial Estate, Marripalem		RIRuO	233	108	A	9	29	15	9	13	21
	Police Barracks		RIRuO	371	108	A	9	48	21	12	21	28
	INS-Virabahu, Naval Area		RIRuO	387	108	A	9	46	16	10	15	23
	Seethammadhara		RIRuO	388	107	A	9	55	16	10	15	23
	Ganapuram Area		RIRuO	467	108	A	9	63	23	13	22	29
	Peddantyada, Gajuwada		RIRuO	584	117	A	9	39	12	9	11	19
	CWMP, RAMKY, Parawada		RIRuO	585	108	A	9	28	10	9	9	12

Andhra Pradesh

State	City	Location	Type	Station code	Category of ES	Air Quality		% exceedence (24 hourly)	Std. Dev.		90 percentile	50 percentile	10 percentile	NO <sub>2</sub> Annual average (µg/m <sup>3</sup> )		
						AIA	Min	Max	AIA	Min						
Assam	Guwahati	Oil India Ltd. Chirang	542	RIRuO	104	A	10	22	5	12	15	18	3	0	L	
		Barpara Office Building	520	RIRuO	104	A	5	28	5	13	15	18	3	0	L	
		BATAD, Baska	566	RIRuO	92	A	8	21	14	11	14	17	2	0	L	
		Dibrugarh Office Building	538	RIRuO	103	A	7	18	14	12	14	16	2	0	L	
		Golaghat Office Building	539	ES	Numaligarh	82	A	9	22	5	11	15	19	3	0	L
		Head Office, Bamunimaidam	193	RIRuO	254	A	9	22	5	11	15	19	3	0	L	
		Boragaon, office premises of IASST, Kamrup	603	RIRuO	33	IA	7	22	5	11	16	19	3	0	-	
		Guwahati University, Kamrup	602	RIRuO	82	A	8	17	3	11	13	16	2	0	L	
		ITI Building, Gopinath Nagar	519	RIRuO	280	A	9	45	6	13	16	19	3	0	L	
		Central Dairy, Khanapara, Kamrup	596	RIRuO	106	A	10	17	3	12	13	15	1	0	L	
Bihar	Patna	Near Pragjyotish College, Santipur	541	RIRuO	264	A	11	23	5	12	15	19	2	0	L	
		Bazar Patti, North Lakhimpur	587	RIRuO	102	A	10	23	5	12	14	18	2	0	L	
		Nagaon Water Resources Div., Christian Patty	595	RIRuO	103	A	7	27	14	10	14	19	3	0	L	
		Nalbari PWD Rural Div Office Complex,	597	RIRuO	82	A	9	26	6	13	16	19	3	0	L	
		Sibasagar Office Building	537	RIRuO	108	A	7	19	14	11	14	16	2	0	L	
		Usha Lodge, near ONGCL Colony	604	RIRuO	24	IA	11	18	3	11	13	16	2	0	-	
		Janiganj Govt. Boys HS School	607	RIRuO	11	IA	13	17	5	13	15	17	1	0	-	
		Office Building of RLO, Ithkola Market	567	RIRuO	92	A	11	22	17	15	17	20	2	0	L	
		Tezpur Office Building	536	RIRuO	104	A	8	18	3	11	13	15	2	0	L	
		Digboi Carbon factory Campus, Borguri	594	RIRuO	99	A	9	20	3	12	13	16	2	0	L	
Tinsukia		Coal India Office Complex, Margherita	586	RIRuO	97	A	15	44	23	18	22	26	4	0	M	
		Shreepuria, Borguri	605	RIRuO	43	IA	7	19	3	12	13	15	2	0	-	
		Beltron Bhawan, Shastri Nagar	210	RIRuO	87	A	11	57	26	15	24	38	9	0	M	
		Gandhi Maidan Test Centre	284	RIRuO	51	A	25	82	55*	36	57	71	14	4	H	

State		City	Location	Type	Station code	No. of mon. days (n)	Category of ES	Air Quality	% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	NO <sub>2</sub> Annual average (µg/m <sup>3</sup> )	Max	Min	A/IA
Chandigarh	Chandigarh		Modern Foods, Industrial Area Sector-17 C	RIRuO	106	149	A	5	45	19	10	17	31	9	0	L	
			Punjab Engineering College, Sector 12	RIRuO	263	150	A	5	40	19	10	17	31	8	0	L	
			Sector-39, IMTECH Kalmbwala Village	RIRuO	264	153	A	5	43	14	5	13	23	7	0	L	
			Visak Hostel, Sector-4 R.O., 5/32 Banglow Office Building	RIRuO	463	150	A	5	38	15	5	14	25	7	0	L	
			M.P. Laghu Udyog Nigam RO, CECB Vyapar Vihar	RIRuO	464	146	A	5	39	12	5	11	18	6	0	L	
			HIG 21.22.Near Ghantaghar, Pragati Nagar NTPC Colony	RIRuO	65	91	A	16	26	22	19	22	25	2	0	M	
			I.T.I., Rampur	RIRuO	67	90	A	11	18	15	13	15	17	2	0	L	
			New HIG-9, Hirapur M/S Wool Worth India, Sarora Raipur	RIRuO	245	87	A	19	33	30	29	31	32	3	0	M	
			Yatayat Thana, Jai Stambh Chowk	RIRuO	407	95	A	20	23	21	20	21	24	5	0	-	
			Rajpur	RIRuO	368	92	A	19	22	21	20	21	22	1	0	M	
Chhattisgarh	Chhattisgarh		Khadoli Industrial Area, Village- Khadoli	RIRuO	249	97	A	16	21	20	19	20	21	1	0	L	
			Dadra & Na- gar Haveli	RIRuO	447	44	IA	17	47	41	39	41	44	4	0	-	
			Daman & Diu	RIRuO	558	94	A	17	20	18	17	17	19	1	0	L	
			N.Y. School, Sarojini Nagar Town Hall, Chandni Chowk	RIRuO	560	96	A	16	20	18	17	17	19	1	0	L	
			Shahzada Bagh Nizamuddin	RIRuO	144	96	A	24	124	68*	41	65	106	23	26	C	
			Pritampura	RIRuO	146	96	A	38	125	76*	53	76	102	19	40	C	
			Shahadra	RIRuO	345	96	A	21	129	72*	42	70	108	25	31	C	
			Sohenzada Bagh Janakpuri	RIRuO	531	81	A	23	65	38	30	37	49	8	0	M	
			Siri Fort	RIRuO	58	80	A	29	58	45*	33	46	55	8	0	H	
			Delhi	RIRuO	57	79	A	20	71	48*	33	47	64	12	0	H	

State	City	Location	Air Quality					
			% exceedence (24 hourly)					
			Std. Dev.					
			90 percentile					
			50 percentile					
			10 percentile					
			NO <sub>2</sub> Annual average (µg/m <sup>3</sup> )					
			Max					
			Min					
			A/IA					
			No. of mon. days (n)					
			Category of ES					
Gujarat			Type	Station code				
			Panaji	Old GSPCB premises, Patto	327	RIRuO	105	A
			Marmagao	Fire Brigade Station, Port Trust	435	RIRuO	118	A
			Vasco	Fuse Call Office of Elec. Dept., Mormugao taluka	37	RIRuO	103	A
			Curchorem	Curchorem, Sanvordem, Quepem	628	RIRuO	19	IA
			Codli	Codli Tisk, Ponda	630	RIRuO	6	IA
			Honda	Honda Junction, Sattari	631	ES	Sahyadri	8
			Bicholim	Bicholim	632	RIRuO	11	IA
			Amona	Amona, Bicholim	633	RIRuO	16	IA
			Assanora	Assanora Junction, Bardez	634	RIRuO	8	IA
			Usgao	Usgao Phae, Junction, Ponda	629	RIRuO	10	IA
			Naroda, G.I.D.C., Ahmedabad	101	RIRuO	104	A	17
			Ahmedabad	Cadilla Bridge, Narol	102	RIRuO	103	A
			L.D. Engg. College	103	RIRuO	104	A	13
			Shardaben Hospital, Saraspur	154	RIRuO	103	A	15
			R.C. High School, Mirzapur	155	RIRuO	104	A	16
			Naroda, G.I.D.C.,	347	RIRuO	104	A	16
			Rallis India Ltd.	252	RIRuO	104	A	17
			Anklesvar	Durga Traders, Bhavanafarm Society	253	RIRuO	104	A
			Jamnagar	Fisheries Office	319	RIRuO	104	A
			Rajkot	Sardhara Industrial Corporation	257	RIRuO	104	A
			Surat	Regional Office	374	RIRuO	104	A
			Vadodara	S.V.R. Engg. College	21	RIRuO	104	A
			Vapi	B.R.C. High School, Udhna	22	RIRuO	114	A
				Air India Office	23	RIRuO	104	A
				GPCB Office, Geri Vasahat	50	RIRuO	96	A
				Dandia Bazaar	333	RIRuO	96	A
				CETP Nandesari	334	RIRuO	96	A
				GEB, IIrd Phase, GLDC, Vapi	367	RIRuO	104	A
				Vapi Nagar Palika, Vapi	221	RIRuO	104	A

State	City	Location	Type	Station code	Category of ES	No. of mon. days (n)	Air Quality		% exceedence (24 hourly)		Std. Dev.		90 percentile		50 percentile		10 percentile		NO <sub>2</sub> Annual average ( $\mu\text{g}/\text{m}^3$ )	
							AIA	Max	Min	AIA	Max	Min	AIA	Max	Min	AIA	Max	Min	AIA	Max
Harayana	Faridabad	Escorts Research Centre Mathura Road RO Haryana SPCB	RIRuO	331	RH	145	A	18	51	26	20	23	37	8	0	0	0	0	0	0
Hissar	Urban Estate - II Guru Jambeishwar University	RIRuO	330	RH	96	A	20	71	31	22	24	50	14	0	0	0	0	0	0	0
Yamunanagar	Ballarpur Industries	RIRuO	390	RH	27	IA	5	10	8	5	8	10	2	0	-	-	-	-	-	-
Baddi	Industry Department Office Building AHC barotiwala	RIRuO	414	RH	52	A	5	10	8	5	8	10	2	0	0	0	0	0	0	0
Damtal	Housing Board Regional Office	RIRuO	196	RH	52	A	21	31	26	22	27	29	2	0	0	0	0	0	0	0
Kala Amb	Old Road Kala Amb Industrial Area	RIRuO	449	RH	93	A	7	56	18	11	16	26	8	0	0	0	0	0	0	0
Nalagarh	Trilokpur Municipal Council	RIRuO	564	RH	83	A	9	48	19	11	16	32	9	0	0	0	0	0	0	0
Parwanoo	Regional Office, Sector- 4 Asst. Commissioner Building, Sector I	RIRuO	563	RH	11	IA	5	19	12	7	12	18	4	0	-	-	-	-	-	-
Shimla	Tekka Bench Ridge Bus Stand, Winterfield	RIRuO	268	RH	148	A	5	40	10	6	9	13	4	0	0	0	0	0	0	0
Jammu & Kashmir	Paonta Sahib Gondhpur Industrial Area	RIRuO	565	RH	271	R	5	18	11	8	12	15	3	0	0	0	0	0	0	0
Jharkhand	M.A. Stadium, Jewel Chowk, Jammu	RIRuO	339	RH	156	A	14	65	22	16	19	23	10	0	0	0	0	0	0	0
Jharkhand	N.M.A. Stadium, Jammu & Kashmir	RIRuO	117	RH	155	A	11	19	15	13	15	17	1	0	0	0	0	0	0	0
Jharkhand	Albert Ekka Chowk, Main Road Saraikeela Khar-sawan	RIRuO	184	RH	66	A	7	53	18	10	16	28	-	0	0	0	0	0	0	0
Karnataka	BIT / PDIL	RIRuO	482	RH	107	A	13	23	17	14	17	21	2	0	0	0	0	0	0	0
West Singhbhum	Barajanda U.M. Office	RIRuO	34	ES	140	A	4	20	11	6	11	15	3	0	0	0	0	0	0	0
Karnataka	Graphite India Yeshwanthpura police station	RIRuO	507	RH	114	A	6	30	17	12	17	21	4	0	0	0	0	0	0	0
Karnataka	Peenya Industrial Area	RIRuO	614	RH	88	A	6	21	12	8	12	16	3	0	0	0	0	0	0	0
Karnataka	Bangalore	RIRuO	402	RH	68	A	30	53	38	34	38	43	4	0	0	0	0	0	0	0

Chapter-4 : Air Quality with Respect to Nitrogen Dioxide (NO<sub>2</sub>)

State	City	Location	Air Quality		% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	NO <sub>2</sub> Annual average (µg/m <sup>3</sup> )						
Karnataka	Bangalore	KHB Industrial Area, Yelahanka	404	RIRuO	107	A	18	75	30	24	30	33	6	0	M	
		AMCO Batteries, Mysore Road	78	RIRuO	100	A	16	41	29	25	30	32	4	0	M	
		Inanabharathi, Bangalore University	598	RIRuO	104	A	—	29	14	8	17	18	5	0	L	
		RV College of Engineering	589	RIRuO	22	A	11	25	19	13	18	23	4	0	-	
		TERI office, Vital Medi healthcare Pvt.Ltd Victoria hospital	406	RIRuO	15	IA	23	244	63	30	48	98	59	13	-	
	Belgaum	Karnataka SPCB Office Building	460	ES	29	IA	19	38	27	20	28	36	6	0	-	
		Government Hospital	459	RIRuO	83	A	5	38	15	9	13	26	7	0	L	
		KSRRTC bus stand building	458	RIRuO	77	A	6	25	13	10	13	16	3	0	L	
		Lakamanahali Industrial Area, Dharwad	432	RIRuO	69	A	10	27	13	10	12	15	3	0	L	
		Rani Chennamma Circle, Hubli	431	RIRuO	95	A	10	28	13	10	13	15	3	0	L	
Kerala	Mangalore	Stides Premises, Balkampady Industrial Area	488	RIRuO	105	A	5	18	8	5	6	13	4	0	L	
		K.R.Circle	40	RIRuO	94	A	17	40	28	21	27	37	6	0	M	
		KSPCB Bldg. Hebbal Ind. Area	328	RIRuO	117	A	16	68	28	19	27	36	8	0	M	
		District Office, Alissery Road	618	RIRuO	120	A	5	6	5	5	5	5	5	0	L	
		DC Mills, Pathirappally	617	RIRuO	120	A	5	8	5	5	5	5	5	-	L	
	Alappuzha	Elloor I	149	RIRuO	90	A	5	11	5	5	6	1	0	0	L	
		Elloor II	29	RIRuO	91	A	5	12	6	5	6	7	2	0	L	
		Irumpanam	30	RIRuO	109	A	5	22	1	8	10	15	3	0	L	
		Ernakulum South	338	RIRuO	109	A	6	30	16	10	15	23	5	0	L	
		VITTLA	562	RIRuO	108	A	6	27	4	9	13	19	4	0	L	
Kerala	Kochi	MG Road Bank Ernakulam	147	RIRuO	109	A	6	30	13	8	12	20	5	0	L	
		Kalamassery	346	RIRuO	108	A	5	35	15	10	14	22	5	0	L	
		KSPCB, District Office, Kadappakada	621	RIRuO	117	A	6	44	19	9	18	30	8	0	L	
		KMMI Chavara	620	RIRuO	56	A	5	26	1	5	11	17	5	0	L	
		Kottayam	187	RIRuO	96	A	22	26	24	23	24	25	1	0	M	
	Pathanamthitta	Vadavathoor	361	RIRuO	96	A	13	16	14	14	14	15	1	0	L	
		Kozhikode City	360	RIRuO	108	A	5	20	10	6	10	14	3	0	L	
		Nallalam	359	RIRuO	108	A	5	18	8	5	7	13	3	0	L	
		Kalkancherry Slimak oils	623	RIRuO	108	A	5	6	5	5	5	5	-	0	L	
		SEPR Refactories India Ltd.	311	RIRuO	121	A	5	12	6	5	5	9	2	0	L	
Trivandrum	Thissur	Near District Office KSPCB, Makkamkunnu	619	RIRuO	120	A	5	37	13	8	13	18	5	0	L	
		KSPCB, District Office, Poonkunnam	624	RIRuO	93	A	5	15	7	5	6	12	3	0	L	
		Sulthan Bathery	622	RIRuO	119	A	5	51	12	5	10	21	8	0	L	
		PRS Hospital/COSMO	419	RIRuO	108	A	15	49	26	21	26	29	4	0	M	
		SNV School	181	RIRuO	109	A	16	50	27	23	27	32	4	0	M	
Wayanad	Kozhikode	VELI	357	RIRuO	106	A	13	24	18	16	18	21	2	0	L	
		PETTAH	358	RIRuO	107	A	19	32	25	22	25	28	3	0	M	

State	City	Location	Type	Air Quality														
				% exceedence (24 hourly)			Std. Dev.			NO <sub>2</sub> Annual average (µg/m <sup>3</sup> )								
90 percentile			50 percentile			10 percentile												
10 percentile																		
NO <sub>2</sub> Annual average (µg/m <sup>3</sup> )																		
Max			Min			A/IA												
No. of mon. days (n)																		
Category of ES																		
Madhya Pradesh	Maharashtra	Maharashtra	Maharashtra	Bhopal	Hamidia Road, M.P. Hastsilp Vikas Nigam	122	RIRuO	73	A	11	67	21	12	19	28	9	0	M
				C E T P Govindpura	123	RIRuO	74	A	1	111	15	7	12	22	13	1	L	
				EID Perry (I) Limited	525	RIRuO	86	A	38	14	22	0	17	21	27	5	M	
				Dewas Metal Section	524	RIRuO	52	A	25	10	16	14	15	19	3	0	L	
				Vikas Nagar	523	RIRuO	79	A	30	11	18	14	17	21	3	0	L	
				Dindayal Nagar	479	RIRuO	71	A	28	12	20	17	20	25	4	0	L	
				Maharaj Bada	478	RIRuO	58	A	31	12	20	16	20	24	4	0	L	
				Polo Ground	127	RIRuO	89	A	8	51	21	11	21	31	8	0	M	
				Kothari Market, M.G. Road	128	RIRuO	94	A	5	48	19	10	20	26	7	0	L	
				Telephone Nagar, Kanadia Road	131	RIRuO	91	A	4	29	13	8	13	17	4	0	L	
				Vijay Nagar	248	RIRuO	21	IA	28	22	25	22	24	27	2	0	-	
				B C I Labour Club	84	RIRuO	91	A	37	15	22	18	21	26	4	0	M	
				Grasim Kalyan Kendra	246	RIRuO	98	A	54	18	26	20	26	30	5	0	M	
				Pt.Deendayal Nagar, Housing Board Colony	532	RIRuO	72	A	21	8	17	15	18	20	2	0	L	
				Sub-divisional Office E/M LightMachinery	343	RIRuO	80	A	9	5	6	5	7	8	1	0	L	
				Regional Office MPPCB	342	RIRuO	96	A	8	5	6	5	6	7	1	0	L	
				Jayant Township	515	RIRuO	13	IA	29	22	26	23	25	28	2	0	-	
				N.T.P.C., Vidyanagar	514	RIRuO	19	IA	21	17	19	17	19	20	1	0	-	
				Waldhan	516	RIRuO	13	IA	15	10	13	11	13	14	1	0	-	
				District Office	527	RIRuO	71	A	30	13	17	14	16	21	3	0	L	
				Regional Office	526	RIRuO	42	IA	11	8	9	8	9	10	1	0	-	
				Mahakal Temple	528	RIRuO	51	A	42	11	14	11	13	15	5	0	L	
				M/s Apurva Oil and Industries Pvt. Ltd	549	RIRuO	88	A	10	18	14	12	14	16	2	0	L	
				Govt College of Engineering	548	RIRuO	97	A	9	16	13	11	13	15	2	0	L	
				Rajkamal Square	547	RIRuO	96	A	10	20	16	13	16	18	2	0	L	
				S.B.E.S. College	511	RIRuO	109	A	12	34	22	15	22	27	5	0	M	
				Collector Office	512	RIRuO	108	A	11	34	19	14	19	24	4	0	L	
				C.A.D.A. Office, Garkheda	513	RIRuO	97	A	11	46	20	14	20	26	6	0	L	
				Badlapur	649	RIRuO	92	A	9	175	73*	27	68	115	37	29	C	

State		City		Location		Category of ES		No. of mon. days (n)		A/A		Min		Max		% exceedence (24 hourly)		Air Quality		
				Grampanchat Ghughus	267	RIRuO	93	A	9	64	27	14	24	43	12	0	M			
				MDC Chandrapur	281	RIRuO	96	A	9	64	26	14	27	41	11	0	M			
				Nagar Parishad	396	RIRuO	97	A	9	75	30	15	28	51	15	0	M			
				Gadchandur Gram Panchayat, Rajura	640	RIRuO	74	A	8	65	23	9	19	39	13	0	M			
				MDC, Tadali	638	RIRuO	62	A	7	40	18	9	18	29	7	0	L			
				Municipal Council, Ballarshah	639	RIRuO	94	A	11	101	34	14	32	55	18	2	M			
				B.J. Market	644	RIRuO	69	A	29	54	43*	36	44	49	5	0	H			
				Girra water tank	645	RIRuO	68	A	31	53	41*	36	41	47	4	0	H			
				MDC Jalgao	646	RIRuO	70	A	41	135	51*	44	50	55	11	-	H			
				University Campus, Shivaji University,	508	ES	100	A	7	12	10	8	10	12	1	0	L			
				Ruikar Trust, Dabholkar Corner, ST Stand	509	ES	Sahyadri	92	A	16	37	26	20	25	33	5	0	M		
				Mahadwar Road, Near Mahalaxmi Temple	510	ES	Sahyadri	20	IA	102	12	29	15	20	25	4	0	-		
				MDC Water Works	641	RIRuO	96	A	9	43	17	10	16	25	6	0	L			
				Terrace of Kshewraj Vidyalya Shyamnagar	642	RIRuO	104	A	9	33	16	9	15	23	5	0	L			
				Terrace of Siddheshwar Sahakari Bank Ganigolai	643	RIRuO	61	A	9	35	16	10	15	22	5	0	L			
				MDC Chalkewadi	489	RIRuO	12	IA	20	53	33	29	32	38	8	0	-			
				Pump House, CETP	490	RIRuO	18	IA	9	61	27	13	27	41	14	0	-			
				Water treatment plant, Bhirwadi	569	RIRuO	66	A	9	75	37	16	34	60	16	0	M			
				EHS, M/s Privi organics Ltd	570	RIRuO	56	A	21	68	42*	26	41	54	11	0	H			
				Mahatma Phule Hall, MNIP	571	RIRuO	50	A	21	57	37	25	37	48	9	0	M			
				Kalbadevi	169	RIRuO	84	A	5	74	17	5	10	34	15	0	L			
				Parel , Ambedkar Road	170	RIRuO	98	A	5	59	16	5	12	37	13	0	L			
				Worli	349	RIRuO	103	A	5	268	23	5	14	40	31	3	M			
				Institution of Engineers	287	RIRuO	86	A	25	85	38	27	35	55	12	2	M			
				Govt. Polytechnic College, Sadar	314	RIRuO	87	A	20	94	38	27	36	50	12	1	M			
				MDC Office Hingana Road	288	RIRuO	83	A	22	78	41*	29	39	56	12	0	H			
				MDC Industrial Area, MIIDC Office, Hingna	165	RIRuO	81	A	5	98	28	10	22	57	9	-	M			
				Maskasath, Itvari	166	RIRuO	98	A	5	125	32	13	27	61	20	3	M			
				NEERI Lab, Nehru Marg	167	RIRuO	96	A	6	75	23	9	21	40	14	0	M			

Maharashtra

State		City		Location		Air Quality											
				% exceedence (24 hourly)													
				Std. Dev.													
				90 percentile													
				50 percentile													
				10 percentile													
				NO <sub>2</sub> Annual average (µg/m <sup>3</sup> )													
				Max													
				Min													
				A/IA													
				No. of mon. days (n)													
				Category of ES													
				Type													
Maharashtra				R.T.O. Colony Tank	259	RIRuO	112	A	16	39	25	19	23	32	5	0	M
				VIP Industrial Area, MIDC Satpura	269	RIRuO	113	A	18	70	27	21	26	33	6	0	M
				Nashik Municipal Council Building	280	RIRuO	111	A	16	41	25	20	24	34	5	0	M
				T.B.I.A, Rabale , Airoli, TTC	491	RIRuO	102	A	16	73	41*	23	41	56	13	0	H
				Dr. D.Y. Patil College, Nerul, TTC	492	RIRuO	104	A	10	58	33	18	35	45	10	0	M
				MPCB Central Lab, Mhape	493	RIRuO	96	A	17	79	42*	22	42	60	14	0	H
				CIDCO Nodal Office Kharagharp	494	RIRuO	105	A	13	77	35	19	34	50	13	0	M
				Panvel Residential Area, Taloja	495	RIRuO	96	A	13	72	34	18	33	49	13	0	M
				MIDC Colomm Facility Building	496	RIRuO	99	A	19	93	49*	30	48	68	15	4	H
				Maratha Chamber of commerce, Bhosari	312	RIRuO	104	A	12	93	37	19	34	56	16	2	M
Pune				State Electricity Board BLDG Nalstop	379	RIRuO	105	A	12	114	39	20	36	59	17	2	M
				Svargate Police Chawki	381	RIRuO	104	A	10	116	42*	19	40	72	21	8	H
				Roha Industrial Association office	572	RIRuO	64	A	20	88	33	23	29	46	12	2	M
				Filter House of MIDC Water works	573	RIRuO	61	A	21	70	35	23	34	49	12	0	M
				Udyog bhavan /SRO, MPCB Sangli	574	RIRuO	105	A	16	43	25	19	24	30	5	0	M
				Sangli- Miraj Primary school Building	575	RIRuO	104	A	14	49	28	20	27	37	7	0	M
				Krishna Valley School	576	RIRuO	104	A	17	55	29	21	28	37	7	0	M
				WIT Campus	299	RIRuO	106	A	30	49	35	33	35	38	3	0	M
				Voronoko School / Chitale Clinic	300	RIRuO	107	A	30	42	35	32	35	38	2	0	M
				Thane Maternity Hospital,Dhobighat,Kopri	303	RIRuO	112	A	9	18	13	10	13	16	2	0	L
Meghalaya				Terrace of Shanu Market,Naupada	304	RIRuO	108	A	11	22	16	13	16	21	3	0	L
				Kolshet and Balkum, Thane West	305	RIRuO	36	IA	11	18	14	12	14	17	2	0	-
				Smt. C. H. M. College Campus	647	RIRuO	99	A	8	128	62*	24	62	94	29	24	C
				Oktroi Naka	648	RIRuO	94	A	8	197	73*	26	68	116	37	38	C
				Byrnihat EPIP, Ri-Bhoi district	568	RIRuO	87	A	5	34	15	7	15	22	6	0	L
				Dawki Terrace building, Jaintia Hills District	588	RIRuO	68	A	5	16	6	5	5	11	3	0	L
				Tura Office building of Add Chief Engineer; Garo Hills District	608	RIRuO	34	IA	5	14	9	6	9	11	2	0	-
				Shillong State Tuberculosis Hospital	340	ES	79	A	5	29	15	8	14	23	6	0	L
				Boards Office Permises, Lumpyngngad	120	ES	54	A	5	6	5	5	5	5	-	0	L
				Khatia, M.G.-Road, Roof Top of Mizoram SPCB	450	ES	104	A	5	10	6	5	5	7	1	0	L
Mizoram				Lapuidhang, Residence of Chairman, MPCB	451	ES	Hill station	104	A	5	8	5	5	5	1	0	L
				Bawngkawn , Roof Top of Mr.K.L. Ber- ema's residence	452	ES	Hill station	104	A	5	11	6	5	6	8	1	0

State	City	Location	Type	Station code	Category of ES	No. of mon. days (n)	A/IA	Min	Max	% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	NO <sub>2</sub> Annual average (µg/m <sup>3</sup> )	Air Quality
										L						
Nagaland	Dimapur	Bank Colony Dhobinala	RIRuO RIRuO	317 448		93 93	A A	5 5	16 14	7 7	5 5	7 7	11 11	3 3	0 0	L
Kohima	Opposite NST Office Opposite War Cemetery	Hill station Hill station	ES ES	609 610		51 42	A IA	5 5	7 7	5 5	5 5	6 6	1 1	0 0	0 0	L
Angul	Industrial Estate NALCO Township	RIRuO RIRuO	RIRuO	70 231		110 100	A A	16 16	25 26	22 19	21 17	23 19	2 2	0 0	0 L	
Balasore	Sahadevkhunta	RIRuO	RIRuO	428		100	A	10	15	12	10	12	13	1	0 0	L
Berhampur	Regional Office Orissa SPCB Capital Police Station	RIRuO RIRuO	RIRuO	429 424		95 105	A A	7 13	18 59	13 19	10 14	13 20	2 22	0 5	0 L	
Bhubneshwar	IRC Village SPCB Building	RIRuO RIRuO	RIRuO	423 322		98 113	A A	10 10	23 23	17 18	14 13	18 19	20 22	3 3	0 0	L
Cuttack	Roof of Traffic Tower, Badambadi R.O. Cuttack Office, Surya Vihar	RIRuO RIRuO	RIRuO	426 425		45 103	A A	14 11	38 25	19 20	15 14	16 21	32 23	7 3	0 0	-
Rayagada	Regional Office Orissa SPCB LPS High School, Jaykaypur	RIRuO RIRuO	RIRuO	428 229		103 103	A A	11 11	25 25	21 21	15 15	21 24	23 3	0 0	0 L	
Rourkela	Regional Office, ORPB IDL Police Out-post, Sonaparbat	RIRuO RIRuO	RIRuO	370 227		94 104	A A	9 9	11 26	11 10	10 10	11 11	11 2	- 0	0 L	
Sambalpur	Filter Plant, PHD Office, Modipara Coal Field Area / MCL AREA	RIRuO RIRuO	RIRuO	427 471		84 66	A A	10 16	21 31	15 26	11 22	15 27	19 28	3 0	0 L	
Talcher	T.T.P.S. Colony	RIRuO	RIRuO	68		103	A	12	28	20	18	20	22	3	0	L
Amritsar	R.O. Focal Point, Amritsar A.I. Platters, Amritsar / VMC	RIRuO RIRuO	RIRuO	487 486		53 57	A A	31 32	39 40	35 38	32 33	36 38	38 38	2 2	0 0	M
Bhatinda	M/s Milk Plant, Ropar M/s Punjab Chemicals and Crop Protection Ltd.	RIRuO RIRuO	RIRuO	506 504		96 128	A A	10 12	38 23	21 15	15 24	20 31	29 6	6 0	0 M	
Dera Bassi	M/s Winsome Yarns Ltd., Barwala Road, Derabassi	RIRuO	RIRuO	505		56 138	A A	12 12	42 42	24 24	15 14	24 15	30 15	6 1	0 0	L
Pathankot/	C-PYTE Building at Dera Baba Nanak M/s Modi Oil and General Mills	RIRuO RIRuO	RIRuO	590 302		53 107	A A	19 21	53 49	34 35	26 28	40 41	6 6	0 0	M	
Gobindgarh	M/s Raj Steel Rolling Mills United Rolling Mills, Mandi Gobindgarh	RIRuO RIRuO	RIRuO	483 353		96 25	A IA	25 22	50 33	30 29	34 24	40 33	4 3	0 0	M	
Jalandhar	Municipal Council Tubewell	RIRuO	RIRuO												-	

State	City	Location	Air Quality							
			% exceedence (24 hourly)							
			Std. Dev.							
			90 percentile							
			50 percentile							
			10 percentile							
NO <sub>2</sub> Annual average (µg/m <sup>3</sup> )			Max							
Min			A/IA							
No. of mon. days (n)			Category of ES							
Station code			Type							
Punjab	Khanna	Markfed Vanaspati, Khanna	485	RIRuO	123	A	20	47		
		AS School, Khanna	484	RIRuO	134	A	22	48		
	Ludhiana	Bharat Nagar Chowk	422	RIRuO	24	IA	27	31		
		Nahar Spinning Mills, Dholeaval Chawk	76	RIRuO	115	A	22	63		
	Patiala	Milk plant, Ferozpur Road	61	RIRuO	131	A	22	49		
		Vishavkarma Chowk	335	RIRuO	126	A	22	61		
	Naya Nangal	M/s Punjab Alkalies & Chemicals Ltd.	420	RIRuO	111	A	10	26		
		M/s NFL Guest House	421	RIRuO	104	A	10	32		
	Puducherry	Ceylon Industries	600	RIRuO	125	A	13	31		
		Fire Brigade Station, Bahera Road, DSTC Office Upstairs, Anna Nagar	599	RIRuO	120	A	11	32		
Rajasthan	Alwar	PIPDIC Ind. Estate Mettupalamayam	64	RIRuO	90	A	7	20		
		Chamber Of Commerce	93	RIRuO	82	A	7	20		
	Jaipur	Regional Office, Rajasthanian SPCB	337	RIRuO	83	A	5	18		
		Gaurav Solvex Ltd. MIA	372	ES	79	A	12	51		
	Jodhpur	RICO Pump House, MIA	373	ES	75	A	8	58		
		Almeri Gate	219	ES	72	A	6	53		
	Udaipur	NIPB Office,Ihalana Doongari	296	RIRuO	1	IA	6	55		
		Office of District Education Officer, Chandpole	298	RIRuO	110	A	12	40		
	Kota	RICO Office, M.I.A.	408	RIRuO	93	A	26	64		
		Regional Office (North), RSPCB, Vidyadarshak Nagar	410	RIRuO	102	A	25	44		
	Udaipur	VKA	297	RIRuO	114	A	28	54		
		DIC Office, Industrial Estate	413	RIRuO	96	A	13	37		
Rajasthan	Jodhpur	Scjati Gate	273	RIRuO	103	A	17	45		
		Basni Industrial Area, RILCO Office	274	RIRuO	97	A	15	40		
	Kota	Maha Mandir Police Thane	376	RIRuO	99	A	16	50		
		Office of Housing Board, Chopasani Road	411	RIRuO	98	A	15	52		
	Udaipur	Shastri Nagar Police Thana	412	RIRuO	102	A	16	44		
		Regional Office, RJPB, Anantpura	17	RIRuO	102	A	16	58		
		Municipal Corporation Building Samcore Glass Ltd.	326	RIRuO	101	A	15	57		
Uttarakhand	Dehradoon	Ambamata	325	RIRuO	103	A	14	59		
		Town Hall	320	RIRuO	92	A	21	43		
		Regional Office,MIA	321	RIRuO	96	A	25	42		

State	City	Location	Type	Station code	Air Quality		% exceedence (24 hourly)			
					Max	Min	A/IA	No. of mon. days (n)	90 percentile	Std. Dev.
		Kathivakkam, Municipal Kalyana Manda-pam	RIRuO	38	100	A	I3	25	18	15
Chennai	Govt. High School, Manali	RIRuO	71	102	A	I2	27	19	17	19
	Thiruvottiyur	RIRuO	72	93	A	I3	31	20	14	20
	Madras Medical College	RIRuO	159	93	A	5	43	12	5	10
	NEERI, CSIR Campus	RIRuO	160	95	A	5	48	10	5	8
	Thiruvottiyur Municipal Office	RIRuO	161	94	A	5	40	10	5	8
	Poniarajapuram, On the top of DEL G.D.Matric Hr.Sec.School	RIRuO	371	50	A	I4	50	21	14	20
Coimbatore	SIDCO Office Kurichi	RIRuO	238	93	A	I1	51	23	15	23
	Highway (Project -I) Building	RIRuO	237	85	A	I2	264	37	17	29
	Fenner (I) Ltd. Susee Cars & Trucks	RIRuO	306	102	A	I3	34	24	20	24
	Kunnathur Chatram Girls HS School	RIRuO	307	92	A	I6	38	25	20	25
	Sowdeswari College Building	RIRuO	308	94	A	I5	73	25	20	25
	Fisheries College	RIRuO	309	96	A	I3	45	26	20	25
Tuticorin	Raja Agencies	RIRuO	239	98	A	I4	31	11	6	10
	Regional Office, Bodla	RIRuO	240	86	A	I2	36	13	7	11
	Nunhai	ES	323	80	A	I9	14	11	10	11
	Tai Mahal	Tai-trapezium	324	79	A	I8	15	12	1	12
	DIC Nunhai	Tai-trapezium	415	287	A	I5	61	19	5	17
	Ermad-uddaulah	Tai-trapezium	416	131	A	I5	67	33	16	32
Agra	Rambagh	Tai-trapezium	417	123	A	I5	53	22	9	21
	Square crossing circle of Laxmi Talkies	Tai-trapezium	554	117	A	I5	55	24	11	23
	Bharat Yantra Nigam Ltd	Tai-trapezium	555	105	A	I4	57	27	9	18
	Arpara Colony, Sonabhadra	Tai-trapezium	6	105	A	I1	46	21	7	14
	Renusagar Colony, Sonabhadra	Tai-trapezium	7	104	A	I9	53	28	3	25
	Center for Development of Glass Industry ( CDGI)	Tai-trapezium	399	87	A	I2	31	27	2	25
Ferozabad	Tilak Nagar	Tai-trapezium	400	104	A	I3	42	35*	4	28
	Raza ka Tal	Tai-trapezium	401	103	A	I2	43	33*	4	25
	Raunaq Auto Ltd, J.P. Nagar	Tai-trapezium	140	101	A	I1	59	32*	5	25
	Indira Chowk, J.P. Nagar	Tai-trapezium	139	85	A	I7	29	23	19	23
	Gajraula	Tai-trapezium		65	A	I9	28	21	16	21
		Tai-trapezium				I6	26	4	0	0
						Uttar Pradesh				

State	City	Location	Type	Category of ES	No. of mon. days (n)	Air Quality		% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	NO <sub>2</sub> Annual average ( $\mu\text{g}/\text{m}^3$ )	
						AIA	Max							
Ghaziabad	M/s Adas Cycles Industries Ltd, Sahibabad Industrial Area	258	RIRuO		97	A	34	41	38	35	37	40	2	0
Ghaziabad	Bulandshaar Road Industrial Area	369	RIRuO		88	A	29	40	36	32	37	39	3	0
Jhansi	Jail Chauraha	517	RIRuO		120	A	18	34	27	21	28	30	9	0
Veeranga Nagar	518	RIRuO			120	A	15	30	24	18	25	28	4	0
Forest & Training Centre, Kidwai Nagar	212	RIRuO			98	A	22	44	34	27	34	41	5	0
Chamber Of Commerce, Darshanpurwa	98	RIRuO			81	A	18	43	33	26	34	41	6	0
Fazalganj	86	RIRuO			80	A	30	50	38	33	38	41	3	0
Dabauli	391	RIRuO			71	A	23	41	33	28	34	39	4	0
Awas Vikas, Jaimau	395	RIRuO			89	A	23	45	32	27	31	38	5	0
Khurja	Central Glass & Ceramic Research Institute	534	RIRuO		58	A	23	38	30	26	31	34	3	0
Airpara	535	RIRuO			58	A	20	28	23	21	24	26	2	0
Mahanagar	377	RIRuO			74	A	28	39	34	30	34	37	2	0
Chandganj Garden, Aliganj	398	RIRuO			109	A	29	40	34	31	34	37	2	0
Kapoor Hotel, Hazratganj	109	RIRuO			82	A	28	38	33	30	34	36	2	0
Talkatora	113	RIRuO			81	A	30	49	36	32	36	39	3	0
S.M.K Chowk, Aminabad	397	RIRuO			103	A	29	41	34	31	34	37	3	0
Meerut	Begum Bridge	550	RIRuO		68	A	35	65	52*	42	53	59	7	0
Thana Railway Road, Kessarganj	551	RIRuO			40	IA	21	61	43	35	41	51	8	0
Bidh Bazar	PTC	RIRuO			28	IA	14	44	25	17	24	38	8	0
Muradabad	Regional Office, UP PCB	403	RIRuO		30	IA	3	31	16	9	15	22	6	0
Noida	Gee-Pee Electroplating and Engineering Work	378	RIRuO		95	A	26	62	46*	35	47	57	8	0
Varanasi	Regional Office, Jawahar Nagar	362	RIRuO		82	A	18	21	20	19	19	20	-	0
Sigra	553	RIRuO			79	A	19	23	20	19	20	20	1	0
Raipur Road, Near parag Diary	90	ES	Doon valley		18	IA	24	32	28	25	28	31	2	0
Clock Tower, PWD Guest House	89	ES	Doon valley		32	IA	27	35	31	29	31	34	2	0
Himalaya Drug Co. Near ISBT	637	ES	Doon valley		-	-	-	-	-	-	-	-	-	-
Govt. Women Hospital	625	RIRuO			-	-	-	-	-	-	-	-	-	-
SDCUJ, Haridwar	635	RIRuO			-	-	-	-	-	-	-	-	-	-
Kashipur	BSNL Office, Kashipur Nagar, Pallika Parishad	627	RIRuO		-	-	-	-	-	-	-	-	-	-
Rishikesh	Asansol Municipal Corporation	636	ES	Hill station	-	-	-	-	-	-	-	-	-	-
Asansol	Kangsabati Spinning Mill, Barjora	386	RIRuO		105	A	49	87	68*	62	67	80	9	12
Burnpur Town Department, Burnpur	592	RIRuO			105	A	47	94	68*	61	68	86	11	12
Barrackpore Municipality	655	RIRuO			102	A	33	118	65*	43	64	92	19	22
Dum Dum Telephone Exchange	653	RIRuO			101	A	40	146	76*	49	116	26	32	0
Khardah Municipality	654	RIRuO			102	A	42	156	80*	52	72	126	28	39
DMC Water Works, Angarpur	591	RIRuO			105	A	39	86	63*	50	61	79	11	10
Durgapur	Kwality Hotel, Bhiringi More, Benachiti	384	RIRuO		105	A	44	94	69*	55	67	84	11	14

West Bengal

Note: \* - Locations where annual mean concentration of  $\text{NO}_2$  exceeded the NAAQS of  $40 \mu\text{g}/\text{m}^3$  for Residential / industrial / other area and  $30 \mu\text{g}/\text{m}^3$  for sensitive area. \*\* - Data not available/outlier/monitored for 16 and more hours a day L- Low, M- Moderate, H - High and C - Critical levels of pollution based on exceedance factor (calculated for  $n \geq 50$  days) classification based on Pollution Level Classification, Chapter 2, Table 2. 1; % violation - percentage violation of NAAQS (24 hourly average) BDL = Below Detection Limit (Concentration less than  $9 \mu\text{g}/\text{m}^3$  for  $\text{NO}_2$ ).

Particulate matter (PM) is a complex mixture of suspended solid and liquid particle in semi equilibrium with surrounding gases. It is classified in different ways:

- a. Classification on emission:
  - Primary PM: Particulate matter is called primary if it is in the same chemical term in which it is emitted into the atmosphere. The primary particulate matter includes wind blown dust such as road dust, fly ash, soot etc.
  - Secondary PM: Particulate matter is called secondary if it is formed by chemical reactions in the atmosphere. Secondary particulate matter include sulphates, nitrates etc.
- b. Classification on size: Table 5.1, Figure 5.1 shows the classification and size of particulate matter

**Table 5.1 Classification of particulate matter**

Fraction	Size range
Respirable suspended particulate metter (RSPM) or PM <sub>10</sub> (thoracic fraction)	<= 10 $\mu\text{m}$ diameter produced by mechanical attrition of industrial dusts lung deposition principally by impaction 2.5 $\mu\text{m}$ – 10 $\mu\text{m}$ is called coarse fraction
Accumulation mode or Fine particles or PM <sub>2.5</sub> (respirable fraction)	<= 2.5 $\mu\text{m}$ in diameter composed mainly of carbonaceous materials (organic and elemental), inorganic compounds (sulfate, nitrate, and ammonium), and trace metal compounds (iron, aluminium, nickel, copper, zinc, and lead) penetrates deeper into the lungs increases respiratory symptoms, causes irritation of the airways, coughing, or difficulty breathing, decreases lung function; aggravates asthma, chronic bronchitis, irregular heartbeat, nonfatal heart attacks, premature death in people with heart or lung disease
Ultrafine particles (UFP)	<= 0.1 $\mu\text{m}$ large surface area to mass ratio making them potential carriers of harmful gaseous compounds cause severe pulmonary inflammation and hemorrhage, high degree of alveolar and interstitial edema, disruption of epithelial and endothelial cell layers and even death

**Figure 5.1: Particulate matter**

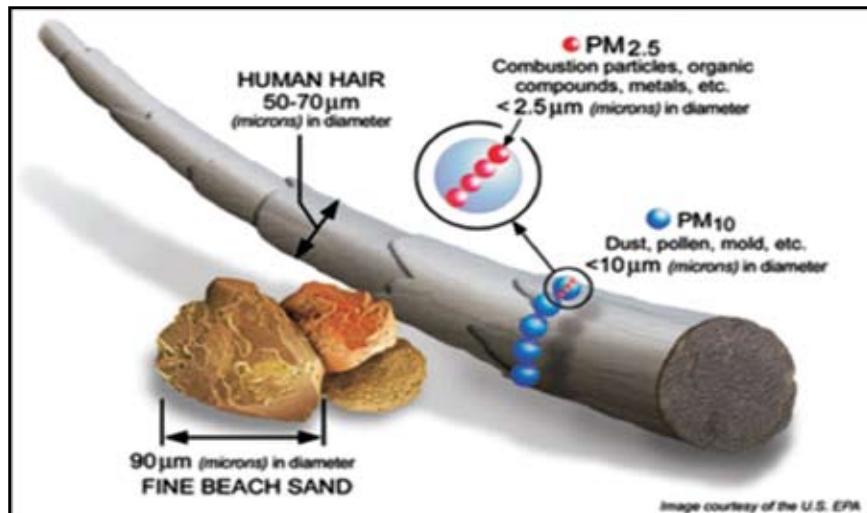


Image courtesy of the U.S. EPA

c. Based on the generation mechanism PM are categorized into

- Dispersion Originated - the particulate originated from wind generated movement in nature as well as man made or from the breakdown from liquid or solid bulk materials, i.e. by grinding, atomization, natural dispersion, wind erosion etc. Eg. Dust (Dispersion Originated) is produced by subdivision of solid material through mechanical actions or in nature. Anthropogenic emissions are generated during grinding or milling of materials, during transfer of finely divided material as well as from agriculture, forestry and construction activities. The larger the particle diameter, they tend to settle faster. The rate of settling also depends on density and shape of particles. Particles larger than 50  $\mu\text{m}$  settle rapidly.
- Condensation Originated - build up from molecular dimension after heating and cooling. Eg. Fumes (Condensation Originated) are produced from hot solid substances by vaporization and condensation usually industrial process originated, combustion originated or from metallurgical processes.
- Mist (Dispersion & Condensation Originated) is generated from liquid by mechanical actions, evaporation and/or condensation of vapors generated from Industrial processes, spraying, electroplating etc.

Respirable Suspended Particulate Matter or PM<sub>10</sub> are the particles with upper size limited by a 50% cut at 10  $\mu\text{m}$  aerodynamic diameter (USEPA, 1996). They consist of particles with a diameter up to 10  $\mu\text{m}$ . The major constituents of PM<sub>10</sub> are organic and elemental carbon, metals/elements like silicon, magnesium, iron, ions like sulphates, nitrates, ammonium etc. PM<sub>10</sub> can be formed by physical processes of crushing, grinding and abrasion of surfaces. Mining and agricultural activities are some of the sources of large size particles. The anthropogenic source are mechanical break-up of larger solid particles, wind blown dust such as road dust, fly ash, soot, agricultural processes, physical processes of crushing, grinding and abrasion of surfaces, photochemically produced particles, such as those found in urban haze, pollen grains, mould spores, and plant and insect parts, combustion of fossil fuel (coal, heavy fuel oil in thermal power plants, office, factories), paper Industry, extraction & distribution of fossil fuels, smelting of metals (sulfide ores to produce copper, lead and zinc), petroleum refining, combustion process in diesel, petrol, natural gas driven vehicles. PM<sub>10</sub> can settle in the bronchi and lungs and cause health problems like respiratory illness, visibility impairment, aggravate existing heart and lung diseases. It also causes visibility reduction. A compilation of sources and effects of PM<sub>10</sub> are given in Annexure I.

In this chapter the a detailed summary of PM<sub>10</sub> levels in the country is furnished. The air quality of different cities/towns has been compared with the respective standard. The air quality has been categorized into four broad categories based on an Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard. The four categories are low, moderate, high and critical levels. The top 10 location, cities and states with maximum PM<sub>10</sub> pollution is furnished.

### **5.1 Locations, cities and states with highest PM<sub>10</sub> values during 2010**

Table 5.2 shows top ten locations in terms of annual average concentration of PM<sub>10</sub>. For residential / industrial / rural / other area in which highest concentration was observed at Dindayal Nagar, Gwalior, Madhya Pradesh and Table 5.3 shows sensitive area in highest concentration was observed at Gaurav Solvex Ltd. MIA, Alwar, Rajasthan. Among the cities Gwalior, Madhya Pradesh tops the list with 308  $\mu\text{g}/\text{m}^3$  PM<sub>10</sub>.(Table 5.4). Among the states Delhi shows highest PM<sub>10</sub> values 261  $\mu\text{g}/\text{m}^3$  (Table 5.5)

**Table 5.2: Ten locations with higher PM<sub>10</sub> values (annual average) during 2010  
(residential / industrial / rural / other area)**

Sl. No.	State	City	Location	Station code	No. of mon. days (n)	Min	Max	Annual average ( $\mu\text{g}/\text{m}^3$ )	Std. Dev.	% exceedence (24 hourly)	Air Quality
1	Madhya Pradesh	Gwalior	Dindayal Nagar	479	75	110	624	361*	118	100	C
2	Delhi	Delhi	Town Hall, Chandni Chowk	146	96	76	1699	354*	201	97	C
3	Chattisgarh	Raipur	M/S Wool Worth India Pvt. Ltd. Sarora	223	51	246	431	349*	45	100	C
4	Delhi	Delhi	Janakpuri	59	78	56	681	306*	128	100	C
5	Jharkhand	West Singhbhum	Barajamda U.M. Office	615	84	59	926	302*	229	83	C
6	Uttar Pradesh	Ghaziabad	Sahibabad Industrial Area	258	97	163	503	301*	88	100	C
7	Uttar Pradesh	Ghaziabad	Bulandshaar Road Industrial Area	369	88	160	517	280*	90	100	C
8	Delhi	Delhi	Mayapuri Industrial Area	345	96	38	702	275*	146	82	C
9	Haryana	Yamunanagar	Ballarpur Industries	196	52	64	523	261*	116	92	C
10	Uttar Pradesh	Allahabad	Crossing circle of Laxmi Talkies	554	105	99	649	254*	348	99	C

\* - Locations where annual mean concentration of PM<sub>10</sub> exceeded the NAAQS of 60  $\mu\text{g}/\text{m}^3$  for Residential/ industrial / other area. Std. dev:standard deviation, mon:monitoring, n:number of monitoring days; L:Low, M:moderate, H:high, C:critical classification based on Pollution Level Classification, Chapter 2, Table 2.1, Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

**Table 5.3: Ten locations with higher PM<sub>10</sub> values (annual average) during 2010  
(Ecologically sensitive area)**

Sl. No.	State	City	Location	Station code	ESA category	No. of mon. days (n)	Min	Max	Annual average ( $\mu\text{g}/\text{m}^3$ )	Std. Dev.	% exceedence (24 hourly)	Air Quality
1	Rajasthan	Alwar	Gaurav Solvex Ltd. MIA	373	Aravali range	75	21	733	300*	163	88	C
2	Uttar Pradesh	Agra	DIC Nunhai	415	Taj-trapezium	128	33	706	248*	148	77	C
3	Uttar Pradesh	Ferozabad	CDGI	399	Taj-trapezium	104	39	332	226*	304	83	C
4	Uttar Pradesh	Ferozabad	Tilak Nagar	400	Taj-trapezium	103	37	320	212*	295	83	C
5	Uttar Pradesh	Ferozabad	Raza ka Tal	401	Taj-trapezium	101	25	312	203*	290	76	C
6	Rajasthan	Alwar	RO, Rajasthan SPCB	372	Aravali range	82	18	728	201*	135	0	C
7	Uttar Pradesh	Agra	Nunhai	324	Taj-trapezium	96	94	283	196*	258	97	C
8	Uttar Pradesh	Agra	Regional Office, Bodla	323	Taj-trapezium	89	96	311	179*	233	99	C
9	Uttar Pradesh	Agra	Etmad-uddaulah	416	Taj-trapezium	123	17	698	179*	132	67	C
10	Rajasthan	Alwar	RIICO Pump House	219	Aravali range	72	55	643	174*	105	0	C

\* - Locations where annual mean concentration of PM<sub>10</sub> exceeded the NAAQS of 60  $\mu\text{g}/\text{m}^3$  for sensitive areas. Std.dev:standard deviation, mon:monitoring, n:number of monitoring days; L:Low, M:moderate, H:high, C:critical classification based on Pollution Level Classification, Chapter 2, Table 2.1, Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

**Table 5.4: Ten cities with highest PM<sub>10</sub> values (annual average) during 2010  
(residential / industrial / rural / other area)**

Sl. No.	State	City	Min	Max	Annual average ( $\mu\text{g}/\text{m}^3$ )	Std. Dev.	Air Quality
1	Madhya Pradesh	Gwalior	598	114	308*	107	C
2	Jharkhand	West Singhbhum	59	926	302*	229	C
3	Uttar Pradesh	Ghaziabad	162	510	290*	89	C
4	Chattisgarh	Raipur	207	370	289*	39	C
5	Delhi	Delhi	46	748	261*	130	C
6	Haryana	Yamunanagar	64	523	261*	116	C
7	Jharkhand	Jharia	131	370	237*	40	C
8	Punjab	Khanna	152	283	231*	23	C
9	Punjab	Gobindgarh	125	534	224*	66	C
10	Punjab	Amritsar	181	258	219*	20	C

\* - Cities where annual mean concentration of PM<sub>10</sub> exceeded the NAAQS of 60  $\mu\text{g}/\text{m}^3$  for Residential/ industrial / other area. L:Low, M:moderate, H:high, C:critical classification based on Pollution Level Classification, Chapter 2, Table 2.1, Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

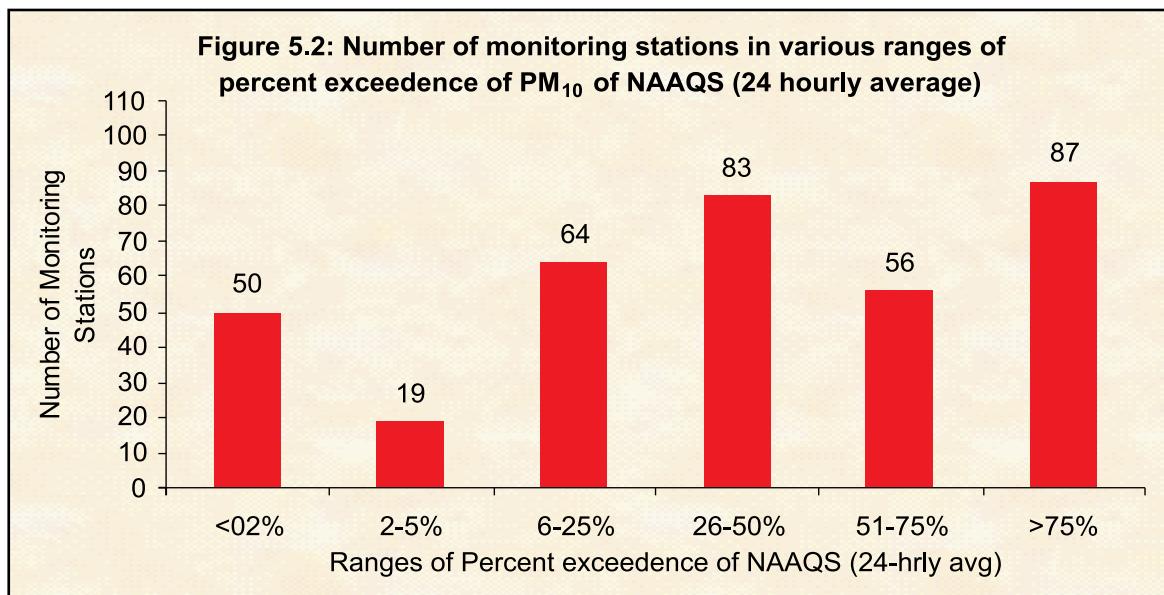
**Table 5.5: Ten states with highest PM<sub>10</sub> values (annual average) during 2010  
(residential / industrial / rural / other & ecologically sensitive area)**

Sl. No.	State	Min	Max	Annual average ( $\mu\text{g}/\text{m}^3$ )
1	Delhi	46	748	261*
2	Jharkhand	84	398	193*
3	Punjab	115	299	187*
4	Uttar Pradesh	96	484	181*
5	Bihar	92	504	171*
6	Chattisgarh	92	263	169*
7	Rajasthan	32	576	168*
8	Haryana	185	149	137*
9	Uttrakhand	36	656	118*
10	Madhya Pradesh	24	308	110*

\* - Locations where annual mean concentration of PM<sub>10</sub> exceeded the NAAQS of 60  $\mu\text{g}/\text{m}^3$  for Residential/ industrial / other area., Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

## 5.2 Percentage exceedence of NAAQS (24 Hourly Average)

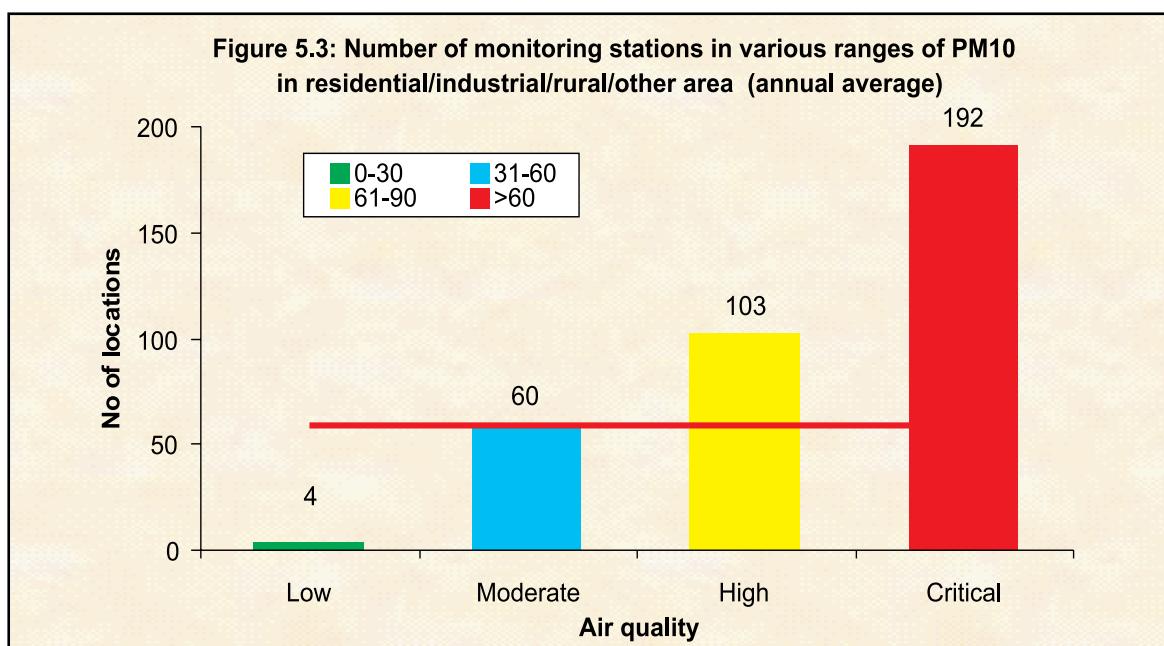
Number of monitoring stations in various ranges of percentage of exceeding limit of NAAQS (24 hourly average) of PM<sub>10</sub> is depicted in Figure 5.2. The percentage exceedence of NAAQS (24 hourly Average) was less than 2% at 50 monitoring stations out of 359 stations. In the remaining 309 stations, the percentage exceedence of NAAQS (24 hourly avg.) was 2% or more.



NB. Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

### 5.3 Air Quality (Low, Moderate, High & Critical)

Number of monitoring stations with low, moderate, high and critical levels of PM<sub>10</sub> is depicted in Figure 5.3. 4 locations showed low PM<sub>10</sub> level, 60 locations showed moderate, 103 high and 192 location were in critical category. Therefore, 295 (82%) locations out of 359 exceeded the NAAQS.



NB. Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

The annual average concentration of PM<sub>10</sub> at various monitoring stations is given in Table 5.6. The data given is annual average concentration and number of observations with 16 and more hours of monitoring a day. Also, described in the table is air quality in terms of low, moderate, high and critical. PM<sub>10</sub> levels at many monitoring stations (with high and critical air quality) exceeded the prescribed NAAQS.

State	City	Location	Type	Air Quality		% exceedence (24 hourly)		Std. Dev.		90 percentile		50 percentile		10 percentile		PM <sub>10</sub> Annual average (μg/m <sup>3</sup> )	
				Max	Min	A/IA	No. of mon. days (n)	Category of ES	Max	Min	A/IA	No. of mon. days (n)	Category of ES	Max	Min	A/IA	No. of mon. days (n)
Guntur	Chittoor	GNC Toll Gate Tirumala	RIRuO	91	A	28	66	31	39	45	7	0	M				
		Near Hindu College, Market Road	RIRuO	583	A	64	97	81*	73	82	90	7	0	H			
		Tanaka, NEERI Lab.	RIRuO	150	A	13	164	63*	28	58	106	31	13	H			
		Nacharam, Industrial Estate	RIRuO	151	A	10	104	38	15	35	69	21	-	M			
		ABIDS Circle General Post Office Building	RIRuO	152	A	18	145	73*	33	71	115	31	21	H			
		Balanagar	RIRuO	95	A	57	160	103*	84	102	122	17	55	C			
Hyderabad	Upal, DA Jubilee Hills Paradise Charminar	Upal, DA Jubilee Hills Paradise Charminar	RIRuO	203	RIRuO	108	A	64	170	100*	78	99	120	18	46	C	
		Zoo Park	RIRuO	365	RIRuO	108	A	28	277	63*	40	58	84	30	8	H	
		Kothaguddem Kurnool Nalgonda	RIRuO	393	RIRuO	108	A	74	204	105*	88	104	120	20	56	C	
		RO, APPCB	RIRuO	394	RIRuO	108	A	72	175	104*	82	105	120	18	59	C	
		Nellore	RIRuO	470	RIRuO	107	A	25	205	63*	35	58	95	27	7	H	
		Kamakhy Temple	RIRuO	581	RIRuO	103	A	41	87	62*	54	60	74	8	3	H	
		Police Station, Ramachandrapuram	RIRuO	466	RIRuO	117	A	35	163	85*	57	84	104	24	13	H	
		Ramagundam	RIRuO	577	RIRuO	108	A	47	146	85*	66	83	110	18	19	H	
		Patencheru	RIRuO	580	RIRuO	94	A	52	78	65*	59	64	71	6	0	H	
		Karimnagar Godavarkhani	RIRuO	468	RIRuO	98	A	28	138	76*	40	75	106	25	18	H	
		Regional Science Centre, Chittoor ByPass	RIRuO	465	RIRuO	99	A	9	168	68*	28	61	121	37	17	H	
		Tirupati Road	RIRuO	389	RIRuO	98	A	23	52	37	31	37	43	5	0	M	
Vijaywada	Benz Circle	RIRuO	462	RIRuO	113	A	50	158	84*	60	75	118	25	23	H		
Warangal	Autonagar	RIRuO	469	RIRuO	113	A	51	169	102*	62	95	147	34	45	C		
	KUDA Office, Hanumakonda	RIRuO	579	RIRuO	102	A	13	139	52	24	43	88	27	5	M		
	Panchayat Rai office, Mindi	RIRuO	234	RIRuO	108	A	21	162	72*	35	69	107	30	17	H		
	Industrial Estate, Marrialem Police Barracks	RIRuO	233	RIRuO	108	A	12	178	70*	33	63	126	35	19	H		
	INS-Virabahu, Naval Area	RIRuO	371	RIRuO	108	A	14	218	96*	45	91	156	43	40	C		
	Seethammadhara Ganapuram Area	RIRuO	387	RIRuO	108	A	23	183	60	36	58	85	23	6	M		
	Peddagantryada, Gajuwada CVWMP RAMKY Parawada	RIRuO	467	RIRuO	108	A	17	151	75*	44	73	112	28	20	H		
	Oil India Ltd. Chirang	RIRuO	588	RIRuO	108	A	22	415	87*	39	79	125	52	30	H		
	Bappara Office Building	RIRuO	520	RIRuO	104	A	9	192	52	20	44	94	35	8	M		
	Daranga BATAD, Baska	RIRuO	566	RIRuO	92	A	11	159	58	22	39	112	38	18	M		
	Diibrugarh Office Building	RIRuO	538	RIRuO	103	A	13	294	38	17	27	63	36	4	M		
	Golaghat	ES	539	Numaligarh	82	A	18	240	73*	23	62	138	50	26	H		
	Head Office, Bamunimaidam Boragaon, office premises of IASST, Kamrup	RIRuO	193	RIRuO	254	A	18	286	105*	33	83	213	67	43	C		
			603	RIRuO	33	A	31	284	71*	39	58	105	45	15	-		
Guwahati	Gujahati University, Kamrup ITI Building, Gopinath Nagar Central Dairy, Khanapara, Kamrup Near Pragjyotish College, Santipur Bazaar Patti, North Lakhimpur Water Resources Div., Christian Patty Nagaon	RIRuO	602	RIRuO	82	A	13	157	64*	28	65	101	30	11	H		
		RIRuO	519	RIRuO	280	A	19	350	111*	37	79	222	74	44	C		
		RIRuO	596	RIRuO	105	A	29	297	109*	42	105	207	62	52	C		
		RIRuO	541	RIRuO	264	A	21	297	104*	35	78	217	69	41	C		
		RIRuO	587	RIRuO	102	A	15	201	76*	26	59	149	49	31	H		
		RIRuO	595	RIRuO	103	A	16	328	103*	23	77	220	80	37	C		

State	City	Location	Type	Air Quality		% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	PM <sub>10</sub> Annual average ( $\mu\text{g}/\text{m}^3$ )
				Max	Min						
Nagaon	Water Resources Div., Christian Party	595	RIRuO	103	A	16	328	103*	23	77	220
Nalbari	PWD Rural Div Office Complex,	597	RIRuO	82	A	14	225	68*	27	50	112
Sibsagar	Sibasagar Office Building	537	RIRuO	107	A	19	319	91*	26	69	183
Usha Lodge, near ONGCL Colony	604	RIRuO	24	IA	10	53	27	17	26	38	9
Janganj Govt. Boys HS School	607	RIRuO	11	IA	39	156	97*	39	102	130	36
Office Building of RLO, Ithkola Market	567	RIRuO	92	A	17	215	66*	28	54	128	40
Tezpur Office Building	536	RIRuO	104	A	12	278	68*	22	50	145	51
Digboi Carbon factory Campus, Borguri	594	RIRuO	99	A	9	220	59	21	38	122	44
Coal India Office Complex, Margherita	586	RIRuO	97	A	17	208	52	21	40	86	33
Shreepuria, Borguri	605	RIRuO	43	IA	18	258	62*	24	49	107	47
Patna	Belttron Bhawan, Shastri Nagar	210	RIRuO	88	A	36	656	118*	53	104	187
Gandhi Maidan Test Centre	284	RIRuO	52	A	45	489	243*	106	251	369	107
Modern Foods, Industrial Area Sector- 17 C	106	RIRuO	148	A	19	600	122*	54	106	202	79
Punjab Engineering College, Sector 12	263	RIRuO	150	A	20	337	85*	37	74	132	48
Sector-39, IMTTECH	264	RIRuO	153	A	16	286	78*	33	65	145	48
Kalmbwala Village	463	RIRuO	150	A	20	369	94*	45	79	158	53
Visak Hostel, Sector-4	464	RIRuO	146	A	18	323	82*	37	70	144	51
R.O., S/32 Banglow Office Building	65	RIRuO	93	A	78	113	96*	82	92	112	12
M.I.P Laghu Udyog Nigam	67	RIRuO	94	A	59	96	82*	73	80	92	8
Bilaspur	M.O. CECD Vypar Vihar HIG 21/22.Near Ghantagharp, Pragati Nagar NTPC Colony	245	RIRuO	88	A	82	170	151*	314	154	168
Korba	I.T.I., Rampur	364	RIRuO	8	IA	108	120	116*	63	118	120
Chhattisgarh	New HIG-9, Hirapur	249	RIRuO	97	A	45	116	89*	69	89	107
Raipur	M/S Wool Worth India, Saora Raipur	407	RIRuO	95	A	56	155	107*	81	112	131
Dadra & Nagar Haveli	Yatayat Thana, Jai Stambh Chowk	368	RIRuO	49	IA	190	347	267*	213	262	317
Daman & Diu	Silvassa	560	RIRuO	96	A	16	106	35	19	24	67
Delhi	Kadaiya Industrial Area, Village- Khadoli N.Y. School, Sarojini Nagar Town Hall, Chandni Chowk Mayapuri Industrial Area Pritampura Shahadra	144	RIRuO	95	A	30	634	228*	52	226	420
		146	RIRuO	96	A	76	1699	354*	147	333	542
		345	RIRuO	96	A	38	702	275*	75	295	449
		531	RIRuO	78	A	35	510	219*	85	220	346
		58	RIRuO	79	A	53	506	254*	89	256	379

State	City	Location	Type	Air Quality		% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	PM <sub>10</sub> Annual average (µg/m <sup>3</sup> )	
				Max	Min							
Goa	Shahzada Bagh	57	RIRuO	83	A	35	885	241*	108	227	381	125
	Nizamuddin	55	RIRuO	60	A	60	568	245*	134	243	357	90
	Jankapuri	59	RIRuO	78	A	56	681	306*	149	308	476	93
	Siri Fort	60	RIRuO	80	A	34	549	230*	92	228	361	100
	Panaji	327	RIRuO	105	A	21	221	85*	36	79	147	89
	Marmagao	435	RIRuO	118	A	19	164	59	27	49	106	30
	Fire Brigade Station, Port Trust											H
	Fuse Call Office of Elec. Dept., Mormugao taluka											M
	Curchorem, Sanvordem, Quepem	628	RIRuO	19	IA	8	94	38	15	35	63	12
	Codli Tisk, Ponda	630	RIRuO	6	IA	70	112	90*	77	89	103	14
	Honda Junction, Sattari	631	ES	Sahyadri	8	IA	91	120	100*	92	95	112
	Bicholim	632	RIRuO	11	IA	76	118	89*	76	89	95	11
	Amona, Bicholim	633	RIRuO	16	IA	37	80	55	43	58	72	13
	Assanora Junction, Bardez	634	RIRuO	8	IA	50	85	71*	55	74	83	12
	Usgao Phae, Junction, Ponda	629	RIRuO	10	IA	136	314	245*	143	273	311	71
Ahmedabad	Naroda, G.I.D.C., Ahmedabad	101	RIRuO	104	A	84	249	151*	95	147	214	50
	Cadila Bridge Narol	102	RIRuO	103	A	44	133	86*	68	86	108	16
	L.D. Engg. College	103	RIRuO	104	A	47	97	70*	56	68	88	11
	Shardaben Hospital, Saraspur	154	RIRuO	103	A	47	136	80*	59	79	105	18
	R.C. High School, Mirzapur	155	RIRuO	104	A	56	140	94*	70	92	119	19
	Naroda, G.I.D.C.,	347	RIRuO	104	A	54	134	87*	65	88	111	18
	Ralis India Ltd	252	RIRuO	104	A	49	110	83*	67	82	99	13
	Anklesvar	253	RIRuO	104	A	46	86	71*	57	72	82	9
	Durga Traders, Bhavanafarm Society											H
	Jamnagar	319	RIRuO	104	A	85	142	104*	94	105	112	8
	Sardhara Industrial Corporation	257	RIRuO	104	A	33	179	115*	84	117	142	26
	Rajkot	374	RIRuO	104	A	46	166	76*	54	76	94	19
	Regional Office											H
	S.V.R. Engg. College	21	RIRuO	104	A	38	86	70*	56	71	81	10
	B.R.C. High School, Udhna	22	RIRuO	114	A	59	105	83*	71	82	94	9
	Air India Office	23	RIRuO	104	A	55	92	75*	65	75	86	8
	GPCB Office, Geri Vasahat	50	RIRuO	96	A	31	91	51	39	52	50	9
	Vadodara	333	RIRuO	96	A	58	181	93*	75	93	111	17
Haryana	Dandia Bazaar											C
	CETP Nandesar	334	RIRuO	96	A	105	168	135*	127	134	156	14
	GEB, IIRD Phase, GIDC, Vapi	367	RIRuO	104	A	62	105	86*	72	86	98	100
	Vapi Nagar Palkia, Vapi	221	RIRuO	104	A	54	94	74*	61	75	85	9
	Escorts Research Centre Mathura Road	331	RIRuO	145	A	109	193	154*	124	157	181	21
	RO Haryana SPCB	330	RIRuO	96	A	143	219	174*	154	172	195	17
	Urban Estate - II	390	RIRuO	27	IA	61	226	93*	66	74	143	38
Hissar	Guru Jambehswar University	414	RIRuO	52	A	52	1082	96*	59	73	100	140
Yamunanagar	Ballarpur Industries	196	RIRuO	52	A	64	523	261*	121	259	400	116

State	City	Location	Type	Air Quality		% exceedence (24 hourly)	Std. Dev.
				90 percentile	50 percentile		
Himachal Pradesh जम्मू-कश्मीर	Baddi	Industry Department Office Building AHC barotiwala Housing Board	RIRuO	96 A	30	361 112*	54 111
	Damtal	Regional Office Old Road	RIRuO	564 RIRuO	85 A	241 103*	52 96
	Kala Amb	Kala Amb Industrial Area	RIRuO	563 RIRuO	11 A	56 100*	59 101
	Nalagarh	Trilokpur Municipal Council	RIRuO	268 RIRuO	150 A	21 165 61*	143 31
	Parwanoo	Regional Office, Sector- 4 Asst. Commissioner Building, Sector I	RIRuO	271 RIRuO	114 A	29 135 75*	58 47
	Paonta Sahib	Paonta Sahib Gondhpur Industrial Area	RIRuO	461 RIRuO	156 A	441 230 55*	141 225 141
	Shimla	Tekka Bench Ridge Bus Stand, Winterfield	RIRuO	530 RIRuO	157 A	24 236 102*	61 96 148
	Jammu	Regional Office, Jammu M.A. Stadium, Jewel Chowk, Jammu	RIRuO	565 RIRuO	66 A	30 221 86*	40 76 148
	Jharkhand झारखण्ड	EMTI, Bastacola CGM Office, Kusunda R.O. Dhanbad	RIRuO	132 RIRuO	153 A	17 292 70*	37 66 102
		Bistupur Vehical Testing Centre Golmuri Vehicle Testing Centre	RIRuO	339 RIRuO	136 A	15 218 98*	48 93 154
		M.A.D.A. Albert Ekka Chowk, Main Road	RIRuO	117 RIRuO	140 A	28 192 108*	69 105 145
		Sarakela Khar- sawan	RIRuO	118 RIRuO	110 A	56 363 162*	99 153 246
		Barajamda Industrial Area, Jammu	RIRuO	34 ES	140 A	10 154 55	24 52 92
		BITT / PDIL	RIRuO	612 RIRuO	72 A	95 365 214*	167 208 259
		West Singhbhum	RIRuO	611 RIRuO	81 A	125 337 211*	153 211 272
		Barajamda U.M. Office	RIRuO	44 RIRuO	75 A	27 390 127*	50 118 226
		Graphite India	RIRuO	351 RIRuO	89 A	99 199 153*	121 148 186
		Yeshwanthpura police station Peenya Industrial Area	RIRuO	382 RIRuO	91 A	81 322 152*	119 156 180
Karnataka कर्नाटक	Iharia	KHB Industrial Area, Yelahanka	RIRuO	332 RIRuO	71 A	131 370 237*	188 237 274
	Ranchi	Albert Ekka Chowk, Main Road	RIRuO	402 RIRuO	111 A	66 340 172*	99 162 239
	Belgaum	AMCO Batteries, Mysore Road	RIRuO	614 RIRuO	86 A	68 336 169*	83 129 205
	Gulburga	Inanabharathi , Bangalore University	RIRuO	46 RIRuO	37 A	57 238 174*	131 179 221
	Hassan	R.V College of Engineering	RIRuO	615 RIRuO	84 A	59 926 302*	80 214 630
	Hubli-Dharwad	TERI office, Vital Medi healthcare Pvt.Ltd	RIRuO	77 RIRuO	59 A	22 513 133*	34 123 226
	Bangalore बंगलोरु	Victoria hospital	RIRuO	457 RIRuO	100 A	23 306 110*	46 101 192
		Karnataka SPCB Office Building	RIRuO	405 RIRuO	99 A	31 505 88*	52 80 127
		Government Hospital	RIRuO	404 RIRuO	106 A	14 265 63*	31 51 100
		KSRRTC bus stand building	RIRuO	78 RIRuO	100 A	24 227 76*	43 63 135
		Lakamanahalli Industrial Area, Dharwad	RIRuO	598 RIRuO	104 A	14 73 42	34 41 48
		Rani Chennamma Circle, Hubli	RIRuO	589 RIRuO	22 A	29 71 56	40 56 70
		Government Hospital	RIRuO	432 RIRuO	14 A	45 350 163*	55 148 310
		KSRRTC bus stand building	RIRuO	406 RIRuO	29 A	35 201 70*	43 61 98
		Lakamanahalli Industrial Area, Dharwad	RIRuO	460 RIRuO	83 A	3 76 33	10 31 57
		Rani Chennamma Circle, Hubli	RIRuO	459 RIRuO	77 A	38 140 65*	46 62 80

State	City	Location	Type	Air Quality		% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	PM <sub>10</sub> Annual average (μg/m <sup>3</sup> )																																																																																																								
				Max	Min																																																																																																														
Mangalore	K.R.Circle Area	Stides Premises, Balkampady Industrial	RIRuO	105	A	21	148	48	32	41	68	21																																																																																																							
Mysore	KSPCB Bldg. Hebbal Ind. Area	40 RIRuO	94 A	23	113	46	33	46	59	13	2	M																																																																																																							
Alappuzha	District Office, Alissery Road	328 RIRuO	117 A	14	73	42	24	41	63	15	0	S																																																																																																							
Kochi	DC Mills, Pathirappally Elor I	618 RIRuO	120 A	5	135	40	17	35	64	22	2	S																																																																																																							
	Elor II	617 RIRuO	120 A	7	174	49	17	41	89	32	8	S																																																																																																							
	Irumpanam	149 RIRuO	90 A	9	214	25	12	20	42	23	1	L																																																																																																							
	Ernakulum South	29 RIRuO	91 A	12	186	31	15	25	50	22	—	S																																																																																																							
	VYTIL A	30 RIRuO	109 A	8	123	37	14	29	72	24	—	S																																																																																																							
Kollam	MG Road Bank Ernakulum Kalamassery	338 RIRuO	109 A	15	86	36	20	30	57	16	0	S																																																																																																							
	KSPCB, District Office, Kadappakkada KMML Chavara	562 RIRuO	108 A	10	95	41	19	35	68	20	0	S																																																																																																							
	Kottayam	147 RIRuO	109 A	7	78	35	15	29	64	18	0	S																																																																																																							
	Vadavathoor	346 RIRuO	108 A	7	115	46	19	44	77	22	—	S																																																																																																							
	Kozhikode City	621 RIRuO	117 A	22	133	57	31	52	87	23	4	S																																																																																																							
	Nallalam	620 RIRuO	56 A	11	117	37	18	30	67	21	4	S																																																																																																							
	Malapuram	187 RIRuO	96 A	47	60	54	50	55	57	3	0	S																																																																																																							
	Palakkad	361 RIRuO	96 A	33	50	41	34	42	47	5	0	S																																																																																																							
	Pathanamthitta	360 RIRuO	108 A	26	55	39	29	37	50	8	0	S																																																																																																							
	Wayanad	359 RIRuO	108 A	23	82	45	30	45	56	11	0	S																																																																																																							
	Thissur	623 RIRuO	108 A	11	42	30	22	32	36	6	0	L																																																																																																							
	Sultan Bathery	311 RIRuO	121 A	6	70	32	20	30	47	11	0	S																																																																																																							
	PRS Hospital/COSMO	619 RIRuO	120 A	10	41	27	19	26	35	7	0	L																																																																																																							
	SMV School VELI	624 RIRuO	93 A	10	142	31	15	23	54	25	3	S																																																																																																							
	Bhopal	622 RIRuO	119 A	23	62	46	34	49	56	9	0	S																																																																																																							
	EID Perry (I) Limited	419 RIRuO	108 A	38	63	50	44	50	58	5	0	S																																																																																																							
	Dewas	181 RIRuO	109 A	33	274	55	44	52	64	23	—	S																																																																																																							
	Dewas Metal Section	357 RIRuO	106 A	36	98	67*	50	68	82	13	0	H																																																																																																							
	Vikas Nagar	358 RIRuO	107 A	35	79	49	43	48	57	6	0	M																																																																																																							
	Dindayal Nagar	523 RIRuO	73 A	29	486	144*	50	126	92	64	C		Maharaj Bada	479 RIRuO	74 A	19	444	121*	28	107	223	91	54	C		Polo Ground	525 RIRuO	88 A	211	32	100*	40	60	90	163	40	C		Indore	524 RIRuO	58 A	112	27	70*	53	69	99	23	7	H		Kothari Market, M.G. Road Telephone Nagar, Kanadia Road	128 RIRuO	94 A	40	336	131*	61	124	214	60	70	C		Jabalpur	131 RIRuO	91 A	30	210	101*	51	104	148	40	54	C		Vijay Nagar	248 RIRuO	21 A	150	119	135*	123	135	146	9	100	-		B C Labour Club	84 RIRuO	97 A	109	55	89*	78	90	100	10	9	H		Nagda	246 RIRuO	100 A	116	59	101*	86	102	112	11	65	C
	Maharaj Bada	479 RIRuO	74 A	19	444	121*	28	107	223	91	54	C																																																																																																							
	Polo Ground	525 RIRuO	88 A	211	32	100*	40	60	90	163	40	C																																																																																																							
	Indore	524 RIRuO	58 A	112	27	70*	53	69	99	23	7	H																																																																																																							
	Kothari Market, M.G. Road Telephone Nagar, Kanadia Road	128 RIRuO	94 A	40	336	131*	61	124	214	60	70	C																																																																																																							
	Jabalpur	131 RIRuO	91 A	30	210	101*	51	104	148	40	54	C																																																																																																							
	Vijay Nagar	248 RIRuO	21 A	150	119	135*	123	135	146	9	100	-																																																																																																							
	B C Labour Club	84 RIRuO	97 A	109	55	89*	78	90	100	10	9	H																																																																																																							
	Nagda	246 RIRuO	100 A	116	59	101*	86	102	112	11	65	C																																																																																																							

Madhya Pradesh

State	City	Location	Type	Air Quality		90 percentile	Std. Dev.	% exceedence (24 hourly)
				Max	Min			
Sagar	Pt.Deendayal Nagar, Housing Board Colony	532 RIRuO	16 IA	100	42	66*	48	64
Satna	Sub-divisional Office E/M LightMachnery Regional Office MPPCB	343 RIRuO	80 A	391	80	252*	116	255
Singrauli	Layant Township N.T.P.C., Vidyanagar	342 RIRuO	96 A	277	74	135*	99	127
Ujjain	Waidhan District Office	514 RIRuO	13 IA	84	67	77*	70	77
Amravati	M/s Apurva Oil and Industries Pvt. Ltd Govt College of Engineering Raikamal Square S.B.E.S. College	549 RIRuO	88 A	79	165	121*	93	121
Aurangabad	Collector Office C.A.D.A. Ofice, Garkheda BIWA Office	548 RIRuO	97 A	37	121	74*	56	74
Badlapur	Grampandhat Ghughus MIDC Chandrapur	547 RIRuO	96 A	79	201	159*	128	154
Chandrapur	Nagar Parishad Gadchandur Gram Panchayat, Rajura MIDC, Tadali Municipal Council, Ballarshah B.J. Market	511 RIRuO	110 A	42	201	91*	56	88
Jalgaon	Gadchandur Gram Panchayat, Rajura MIDC Jalaon University Campus, Shivaji University, Ruikar Trust, Dabholkar Corner, ST Stand Mahadwar Road, Near Mahalaxmi Temple MIDC Water Works	512 RIRuO	108 A	29	116	68*	43	69
Kolhapur	Terrace of Kshewraj Vidyalaya Shyamangar	513 RIRuO	103 A	32	128	65*	36	62
Latur	Terrace of Sidheshwar Sahakari Bank Gangolai	646 RIRuO	92 A	31	212	112*	57	113
Lote	MIDC Chalkevadi Pump House, CETP	508 ES	Sahyadri	101 A	42	214*	81	215
Mahad	Water treatment plant, Bhirwadi EHS, M/s Privt organics.ltd	509 ES	Sahyadri	92 A	76	137	83	102
Mumbai	Mahatma Phule Hall, MNP Kalbadevi Patel , Ambedkar Road Worli	510 ES	Sahyadri	102 A	65	127	92*	108
		641 RIRuO		99 A	19	174	85*	33
				104 A	29	224	126*	88
								122
								177
								34
								83
								C

Maharashtra

State	City	Location	Air Quality		% exceedence (24 hourly)	
			Std. Dev.		90 percentile	
			50 percentile		10 percentile	
			PM <sub>10</sub> Annual average (µg/m <sup>3</sup> )	Max	Min	A/IA
		No. of mon. days (n)		Max	Min	A/IA
		Category of ES	Type	Station code		No. of mon. days (n)
Nashik	Navi Mumbai	Institution of Engineers Govt. Polytechnic College, Sadar MIDC Office Hingna Road	287 RIRuO	87 A 41	329 360	110* 104*
		MIDC Industrial Area, MIDC Office, Hingna	314 RIRuO	88 A 37	62	96 154
		Maskasath, Itwari	288 RIRuO	83 A 27	295	129* 114
		NEERI Lab, Nehru Marg	166 RIRuO	98 A 17	347	106* 101
		R.O. Colony Tank	167 RIRuO	96 A 13	221	81* 67
		VIP Industrial Area, MIDC Satpura	259 RIRuO	112 A 22	204	73* 37
		Nashik Municipal Council Building	269 RIRuO	113 A 19	208	80* 35
		TB.A, Rabale, Airoli, TTC	280 RIRuO	111 A 23	189	77* 44
		Dr. D.Y. Patil College, Nerul, TTC	491 RIRuO	102 A 27	271	102* 55
		MPCB Central Lab, Mhape	492 RIRuO	104 A 22	246	86* 36
Pune	Solapur	MPCD Nodal Office Kharagar	493 RIRuO	96 A 43	224	99* 57
		Paravel Residential Area, Taloja	494 RIRuO	105 A 19	393	95* 49
		MIDC Collom Facility Building	495 RIRuO	96 A 31	312	99* 49
		Maratha Chamber of commerce, Bhosari	496 RIRuO	99 A 63	389	198* 101
		State Electricity Board BLDG Nalstop	312 RIRuO	104 A 15	219	83* 27
		Swargate Police Chowki	379 RIRuO	105 A 22	370	84* 33
		Roha Industrial Association office	381 RIRuO	105 A 11	236	80* 24
		Filter House of MIDC Water works	572 RIRuO	64 A 29	197	85* 45
		Udyog bhavan / SRO, MPCB Sangli	573 RIRuO	61 A 30	209	93* 51
		Sangli- Mirai Primary school Building	574 RIRuO	105 A 9	114	50 19
Thane	Ulhasnagar	Krishna Valley School   WIT Campus	575 RIRuO	104 A 14	163	62* 22
		Voronoko School / Chitale Clinic	576 RIRuO	104 A 17	155	73* 26
		Maternity Hospital Dhobighat, Kopri	299 RIRuO	106 A 34	118	68* 47
		Terrace of Shahu Market, Naupada	300 RIRuO	107 A 34	128	64* 44
		Kolshet and Balkum, Thane West	304 RIRuO	117 A 45	61	49 46
		Smt. C. H. M. College Campus	305 RIRuO	37 IA 46	61	50 48
		Ostroi Nakla	647 RIRuO	99 A 28	161	96* 52
			648 RIRuO	94 A 49	250	117* 64
						114 163
						41 68
Raigad	Zigoram	Byrnihat	568 RIRuO	87 A 143	257	175* 157
		Dawki	588 RIRuO	68 A 27	123	71* 41
		Tura	608 RIRuO	34 IA 44	77	63* 52
		Shillong	340 ES	Hill station 79 A 65	124	103* 89
		State Tuberculosis Hospital	120 ES	Hill station 54 A 40	75	56 45
		Boards Office Premises, Lumpyngngad	450 ES	Hill station 104 A 26	78	43 31
		Khatla, M.G-Road, Roof Top of Mizoram SPCB				57 11
		Laipuitlang, Residence of Chairman, MPCB	451 ES	Hill station 104 A 17	64	33 23
		Bawngkawn , Roof Top of Mr.K.L. Bera's residence	452 ES	Hill station 104 A 30	81	49 30
						47 47

State	City	Location	Type	Air Quality		% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	PM <sub>10</sub> Annual average (μg/m3)	
				Max	Min			A/IA	No. of mon. days (n)	Category of ES		
Nagaland	Dimapur	Bank Colony Dhobinala	RIRuO	93	A	12	201	77*	24	65	153	48
	Kohima	Opposite NST Office Opposite War Cemetery Industrial Estate NALCO Township Sahadevkhunta	RIRuO RIRuO RIRuO RIRuO	93	A	12	202	75*	23	71	129	44
	Angul	Regional Office Orissa SPCB	RIRuO	610	ES	51	A	9	112	53*	16	43
	Balasore	Capital Police Station IRC Village SPCB Building	RIRuO RIRuO	70	RIRuO	114	A	45	215	146*	77	157
	Berhampur	Root of Traffic Tower, Badambadi R.O. Curtack Office, Surya Vihar	RIRuO	231	RIRuO	100	A	27	179	75*	49	75
	Bhubneshwar	SPCB Building	RIRuO	428	RIRuO	100	A	39	104	73*	53	73
	Cuttack	Regional Office Orissa SPCB LPS High School, Jaykaypur	RIRuO	429	RIRuO	95	A	19	177	58	37	55
	Rayagada	Regional Office, ORPB	RIRuO	424	RIRuO	105	A	37	381	97*	43	88
	Rourkela	IDL Police Out-post, Sonaparbat	RIRuO	423	RIRuO	98	A	22	144	70*	44	64
	Sambalpur	Filter Plant, PHD Office, Modipara Coal Field Area / MCL AREA	RIRuO	322	RIRuO	113	A	32	173	84*	47	85
Orissa	Talcher	T.T.P.S.Colony	RIRuO	426	RIRuO	105	A	33	186	77*	41	65
	Amritsar	R.O. Focal Point, Amritsar A-I Platters, Amritsar / VMC	RIRuO	425	RIRuO	45	A	26	260	71*	34	51
	Bhatinda	M/s Milk Plant, Ropar	RIRuO	428	RIRuO	103	A	12	77	54	26	58
	Dera Bassi	M/s Punjab Chemicals and Crop Protection Ltd. M/s Winsome Yarns Ltd., Barwala Road, Derabassi	RIRuO	506	RIRuO	96	A	120	338	216*	32	65
	Gobindgarh	C-PYTE Building at Dera Baba Nanak M/s Modi Oil and General Mills M/s Raj Steel Rolling Mills	RIRuO	504	RIRuO	128	A	78	316	184*	97	111*
	Jalandhar	United Rolling Mills, Mandi Gobindgarh	RIRuO	505	RIRuO	87	A	50	223	140*	100	141
	Khanna	Municipal Council, Tubbewell Marked Vanaspati, Khanna AS School, Khanna	RIRuO	590	RIRuO	56	A	55	97	76*	63	75
	Ludhiana	Bharat Nagar Chowk Nahar Spining Mills, Dholewal Chawlk Milk plant, Ferozpur Road Vishavkarma Chowk	RIRuO	302	RIRuO	107	A	95	519	214*	158	207
	Naya Nangal	M/s Punjabi Alkalies & Chemicals Ltd. M/s NFL Guest House	RIRuO	301	RIRuO	123	A	147	543	232*	181	220
	Patiala	Ceylon Industries Fire Brigade Station, Bahera Road,	RIRuO	483	RIRuO	97	A	131	540	225*	163	214

State	City	Location	Type	Category of ES	Air Quality		% exceedence (24 hourly)	Std. Dev.	90 percentile	50 percentile	10 percentile	PM <sub>10</sub> Annual average ( $\mu\text{g}/\text{m}^3$ )																					
					Max	Min																											
Puducherry	Puducherry	DSTC Office Upstairs, Anna Nagar PIP DIC Ind. Estate Mettupalayam Chamber Of Commerce	RIRuO	90 A	13	72	38	24	38	54	12	0 M																					
		337 RIRuO	82 A	18	97	47	31	45	69	16	0	M																					
Alwar		Regional Office, Rajasthan SPCB Gaurav Solvex Ltd. MIA RICO Pump House, MIA	ES Aravali range ES Aravali range ES Aravali range	83 A 82 A 75 A	12	53	28	17	26	39	9	0 L																					
		219 Ameri Gate	RIRuO	72 A	55	643	174*	77	148	284	105	0 C																					
Jaipur		RIPB Office, Jhalana Doongari Office of District Education Officer, Chandpole RICO Office, M.I.A. Regional Office (North), RSPCB, Vidya- har Nagar VKIA	RIRuO	296 RIRuO 298 RIRuO 408 RIRuO 410 RIRuO 409 RIRuO	1 A	21	388	131*	50	96	249	-																					
		297 RIRuO 413 RIRuO 273 RIRuO Sofati Gate Basni Industrial Area, RICO Office Maha Mandir Police Thane	RIRuO	114 A 96 A 103 A 97 A 99 A 98 A	62	637	246*	93	252	395	122	63 C																					
Jodhpur		Office of Housing Board, Chopasani Road Shaastri Nagar Police Thana Regional Office, RJPB, Anantpura Municipal Corporation Building Samcor Glass Ltd. Ambaramata Town Hall	RIRuO	411 RIRuO 412 RIRuO 17 RIRuO 326 RIRuO 325 RIRuO 92 A 95 A 321 RIRuO	38	1100	198*	93	172	321	91	92 C																					
Kota			RIRuO	101 A 103 A 20 A 30 A 29 A 45 A	22	303	119*	39	177	349	116	86 C																					
Udaipur			RIRuO	102 A 102 A 102 A 101 A 103 A 92 A 95 A 86 A	24	436	155*	41	142	272	91	69 C																					
		Kathivakkam, Municipal Kalyana Manda- pam Govt. High School, Manali Thiruvottiyur Madras Medical College NEERI CSIR Campus Thiruvottiyur Municipal Office Poniarajapuram, On the top of DEL G.D.Matric Hr.Sec. School	RIRuO	38 RIRuO 71 RIRuO 72 RIRuO 159 RIRuO 160 RIRuO 161 RIRuO 371 RIRuO 238 RIRuO 237 RIRuO 306 RIRuO 307 RIRuO 308 RIRuO 309 RIRuO 239 RIRuO 240 RIRuO 323 ES 324 ES	29	213	78*	46	74	113	31	15 H																					
		321 RIRuO 38 RIRuO 71 RIRuO 72 RIRuO 159 RIRuO 160 RIRuO 161 RIRuO 371 RIRuO 238 RIRuO 237 RIRuO 306 RIRuO 307 RIRuO 308 RIRuO 309 RIRuO 239 RIRuO 240 RIRuO 323 ES 324 ES	RIRuO	23 RIRuO 102 A 93 A 93 A 95 A 95 A 81 A 100 A 93 A 103 A 93 A 97 A 118 A 100 A 90 A 96 A 13 A	29	239	80*	55	73	127	34	25 H																					
			RIRuO	31 RIRuO 80 RIRuO 9 RIRuO 14 RIRuO 10 RIRuO 10 RIRuO 125 RIRuO 17 RIRuO 19 RIRuO 83 RIRuO 107 RIRuO 147 RIRuO 250 RIRuO 1184 RIRuO 51 RIRuO 347 RIRuO 49 RIRuO 30 RIRuO 835 RIRuO 75* RIRuO 601 RIRuO 311 RIRuO 283 RIRuO 17 RIRuO 13 RIRuO 17 RIRuO 19 RIRuO 140 RIRuO 123 RIRuO 179 RIRuO 196 RIRuO 167* RIRuO 592 RIRuO 13 RIRuO 286 RIRuO 1 RIRuO 415 RIRuO	242 RIRuO 54 RIRuO 33 RIRuO 17 RIRuO 10 RIRuO 147 RIRuO 55 RIRuO 125 RIRuO 39 RIRuO 107 RIRuO 147 RIRuO 50 RIRuO 55 RIRuO 1184 RIRuO 835 RIRuO 347 RIRuO 601 RIRuO 311 RIRuO 283 RIRuO 17 RIRuO 13 RIRuO 17 RIRuO 19 RIRuO 140 RIRuO 123 RIRuO 179 RIRuO 196 RIRuO 167* RIRuO 592 RIRuO 13 RIRuO 286 RIRuO 1 RIRuO 415 RIRuO	84* RIRuO 54 RIRuO 39 RIRuO 17 RIRuO 19 RIRuO 18 RIRuO 21 RIRuO 37 RIRuO 17 RIRuO 38 RIRuO 10 RIRuO 18 RIRuO 50 RIRuO 55 RIRuO 1184 RIRuO 835 RIRuO 347 RIRuO 601 RIRuO 311 RIRuO 283 RIRuO 17 RIRuO 13 RIRuO 17 RIRuO 19 RIRuO 140 RIRuO 123 RIRuO 179 RIRuO 196 RIRuO 167* RIRuO 592 RIRuO 13 RIRuO 286 RIRuO 1 RIRuO 415 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State	City	Location	Category of ES	Type	Station code	Air Quality	% exceedence (24 hourly)	PM <sub>10</sub> Annual average (µg/m <sup>3</sup> )	
						Std. Dev.	90 percentile		
						50 percentile	10 percentile		
						Max	Min		
						A/A	No. of mon. days (n)		
						Max	Min		
Allahabad	Etmad-uddaulah	416	ES	Taj-trapezium	123	A	17	698	179*
	Rambagh	417	ES	Taj-trapezium	118	A	21	431	143*
	Square crossing circle of Laxmi Talkies	554	RIRuO		105	A	99	649	254*
	Bharat Yantra Nigam Ltd	555	RIRuO		105	A	58	466	181*
	Anpara Colony, Sonabhadra	6	RIRuO		104	A	86	312	128*
	Renusagar Colony, Sonabhadra	7	RIRuO		96	A	93	166	129*
Ferozabad	Center for Development of Glass Industry(CDG)	399	ES	Taj-trapezium	104	A	39	332	226*
	Tilak Nagar	400	ES	Taj-trapezium	103	A	37	320	212*
	Raza ka Tal	401	ES	Taj-trapezium	101	A	25	312	203*
	Raunaq Auto Ltd, J.P. Nagar	140	RIRuO		88	A	70	132	94*
	Indira Chowk, J.P. Nagar	139	RIRuO		71	A	54	170	81*
	M/s Atlas Cycles Industries Ltd, Sahibabad	258	RIRuO		97	A	163	503	301*
Ghaziabad	Industrial Area	369	RIRuO		88	A	160	517	280*
	Bulandshaar Road Industrial Area	517	RIRuO		120	A	92	292	131*
	Jail Chauraха	518	RIRuO		120	A	72	184	106*
	Veeranga Nagar	212	RIRuO		98	A	137	248	200*
	Forest & Training Centre, Kidwai Nagar	98	RIRuO		91	A	59	252	207*
	Chamber Of Commerce, Darshampurwa	86	RIRuO		81	A	145	273	221*
Kanpur	Fazalganj	391	RIRuO		80	A	131	308	196*
	Dabauli	395	RIRuO		93	A	126	254	194*
	Awas Vikas, Jajmau	534	RIRuO		58	A	157	292	191*
	Central Glass & Ceramic Research Institute	535	RIRuO		58	A	136	200	155*
	Ahirpara	377	RIRuO		74	A	135	228	185*
	Mahanagar	398	RIRuO		109	A	103	6307	243*
Lucknow	Chandganj Garden, Aliganj	109	RIRuO		82	A	129	236	192*
	Kapoors Hotel, Hazratganj	113	RIRuO		81	A	150	243	205*
	Takatora	397	RIRuO		102	A	147	304	194*
	S.M.K Chowk, Aminabad	550	RIRuO		69	A	109	286	178*
	Begum Bridge	551	RIRuO		42	A	104	280	155*
	Thana Railway Road, KesarGANJ	PTC	RIRuO		28	A	57	569	221*
Noida	Budh Bazar	403	RIRuO		30	A	46	480	169*
	Regional Office, UP PCB	378	RIRuO		95	A	65	168	130*
	Gee-Pee Electroplating and Engineering Work	378	RIRuO		96	A	71	194	134*
	Regional Office, Jawahar Nagar	362	RIRuO		24	A	122	136	128*
	Sigra	553	RIRuO		8	A	126	128	127*
	Rajpur Road, Near parag Diary Clock Tower, PWD Guest House	90	ES	Doon valley	30	A	80	69	121*
Dehradun	Himalaya Drug Co. Near ISBT	89	ES	Doon valley	50	A	92	263	169*
	Dehradun	637	ES	Doon valley	3	A	158	236	195*
	Haldwani	625	RIRuO		1	A	-	196*	-
	Haridwar	635	RIRuO		3	A	100	179	139*
	Kashipur	627	RIRuO		1	A	-	107	-
	Rishikesh	636	ES	Hill station	3	A	186	238	212*
Uttarakhand	Nagar-Palika Parishad				191		199	212	26
					100		100	-	-
					100		100	-	-
					100		100	-	-
					100		100	-	-
					100		100	-	-

Note: \* - Locations where annual mean concentration of  $PM_{10}$  exceeded the NAAQS of  $60 \mu\text{g}/\text{m}^3$  for Residential/ industrial / other area and  $60 \mu\text{g}/\text{m}^3$  for sensitive area. \*\* - Data not available/ not available/not classified as monitoring days  $<50$  days/RIRUO - Residential/industrial/rural/other area, ES - Ecologically sensitive area, mon - monitoring Std dev - Standard deviation, n - number of days monitored for 16 and more hours a day L- Low, M- Moderate, H - High and C - Critical levels of pollution based on exceedence factor (calculated for  $n \geq 50$  days) classification based on Pollution Level Classification, Chapter 2, Table 2.1; % violation - percentage violation of NAAQS (24 hourly average) BDL = Below Detection Limit (Concentration less than  $5 \mu\text{g}/\text{m}^3$  for  $PM_{10}$ ).

Particulate matter (PM) is a complex mixture of suspended solid and liquid particle in semi equilibrium with surrounding gases. The high Suspended particulate matter (SPM) levels lead to greater prevalence of health effects depicting sub-clinical effects, impaired pulmonary function, respiratory symptoms, medication use, excess doctor room visit, asthma and bronchitis. The majority of the symptoms are reversible because of better health facilities and greater awareness about diseases. The wide spread criticality of SPM problem in the country is due to the synergistic effect of natural factors like presence of extensively large arid and semi arid region in north west region, loss of moisture from top soil strata, distribution of sea salts with sea winds, natural formation of sulfate and nitrates during secondary reactions. The anthropogenic factors responsible for high SPM are extensive urbanization and construction activities, vehicular population increase, frequent use of captive power generation unit/domestic generation, extensive use of fossil fuel and biomass (wood, leaves etc.) as well as particulate contribution from biological debris.

As the SPM are the bigger than coarse particles, these settle down fast and does not reach the respiratory tract. Therefore they have less adverse effect on health. As a result it has not been included in the revised standard. However, as it had been measured during 2010 the data is being given in this chapter.

### **6.1 Annual average concentration of SPM**

The annual average concentration of SPM at various monitoring stations is given in Table 6.1. The data given is annual average concentration and number of observations with 16 and more hours of monitoring a day. In addition to above the spread of the data has been given in terms of standard deviation.

**Table 6.I: SPM levels (Annual average) in Ambient Air Quality Stations under NAMP during 2010**

State	City	Location	Type	Station code	Category of ES	No. of mon. days (n)	A/IA	Min	Max	Std. Dev.	SPM Annual average ( $\mu\text{g}/\text{m}^3$ )				
							Andhra Pradesh								
Hyderabad	Chittoor	GNC Toll Gate Tirumala	RRuO	582	RRuO	91	A	86	137	112	13				
	Guntur	Near Hindu College, Market Road	RRuO	583	RRuO	102	A	157	285	206	24				
	Tarnaka, NEERI Lab.	Nacharam, Industrial Estate	RRuO	150	RRuO	96	A	48	345	170	54				
	Nacharam, Industrial Estate	ABIDS Circle General Post Office Building	RRuO	151	RRuO	95	A	21	225	107	47				
	Balangsar	Uppal, IDA	RRuO	152	RRuO	95	A	58	300	156	56				
	Jubilee Hills	Paradise	RRuO	95	RRuO	108	A	194	413	302	38				
	Jubilee Hills	Charminar	RRuO	203	RRuO	108	A	183	361	282	37				
	Zoo Park	Zoo Park	RRuO	365	RRuO	108	A	69	379	167	52				
	Kothagudem	CER Club, Khamam	RRuO	393	RRuO	108	A	204	536	298	39				
	Kurnool	Mourya Inn	RRuO	581	RRuO	103	A	86	178	174	18				
	Nalgonda	RO, APPCB	RRuO	466	RRuO	117	A	133	400	214	56				
	Nellore	Kamakhy Temple	RRuO	577	RRuO	108	A	118	315	192	36				
	Patancheru	Police Station, Ramachandrapuram	RRuO	580	RRuO	94	A	88	156	130	13				
	Ramagundam	Karimnagar Godavarkhani	RRuO	468	RRuO	98	A	81	301	188	51				
Visakhapatnam	Tirupati	Regional Science Centre, Chittoor Bypass Road	RRuO	465	RRuO	99	A	39	788	224	133				
	Vijaywada	Benz Circle	RRuO	389	RRuO	98	A	77	151	110	15				
	Vijaywada	Autonagar	RRuO	462	RRuO	113	A	128	331	224	51				
	Warangal	KUDA Office, Hanumakonda	RRuO	469	RRuO	113	A	120	430	261	86				
	Panchayat Raj office, Mindi	Panchayat Raj office, Mindi	RRuO	579	RRuO	102	A	43	351	140	65				
	Industrial Estate, Marriparel	Industrial Estate, Marriparel	RRuO	234	RRuO	108	A	50	267	133	44				
	Police Barracks	Police Barracks	RRuO	233	RRuO	108	A	29	388	152	72				
	INS-Virabahu, Naval Area	INS-Virabahu, Naval Area	RRuO	371	RRuO	108	A	33	491	222	97				
	Seethammadhara	Seethammadhara	RRuO	387	RRuO	108	A	47	356	120	45				
	Ganapuram Area	Ganapuram Area	RRuO	388	RRuO	108	A	49	361	156	58				
Assam	Peddgantryada, Gajuwada	Peddgantryada, Gajuwada	RRuO	467	RRuO	108	A	49	797	192	108				
	CWMP, RAMKY, Parawada	CWMP, RAMKY, Parawada	RRuO	584	RRuO	117	A	33	262	131	51				
	Oil India Ltd., Chirang	Oil India Ltd., Chirang	RRuO	585	RRuO	108	A	33	207	87	33				
	Barpara Office Building	Barpara Office Building	RRuO	542	RRuO	104	A	29	403	121	98				
	BATAD, Baska	BATAD, Baska	RRuO	520	RRuO	104	A	22	419	104	74				
	Daranga	Dibrugarh Office Building	RRuO	566	RRuO	92	A	30	347	123	79				
	Dibrugarh	Golaghat Office Building	RRuO	538	RRuO	103	A	26	332	81	49				
Guwahati	Golaghat	Head Office, Bamunimaidam	ES	539	Numaligarh	82	A	28	340	123	73				
	Boragaon, office premises of IASST, Kamrup	Boragaon, office premises of IASST, Kamrup	RRuO	193	RRuO	254	A	29	599	194	119				
	Guwahati University, Kamrup	Guwahati University, Kamrup	RRuO	603	RRuO	33	IA	51	595	133	92				
	[TI] Building, Gopinath Nagar	[TI] Building, Gopinath Nagar	RRuO	602	RRuO	82	A	35	408	130	64				
				519	RRuO	280	A	40	597	202	128				

State	City	Location	Type	Station code	Category of ES	No. of mon. days (n)	A/IA	Min	Max	Std. Dev.	SPM Annual average ( $\mu\text{g}/\text{m}^3$ )
											98
											190
Assam		Central Dairy, Khanapara, Kamrup	RRuO	596	RuO	106	A	56	494	539	178
		Near Pragjyotish College, Santipur	RRuO	541	RRuO	264	A	36	348	348	143
		Lakhimpur Bazar Patti, North Lakhimpur	RRuO	587	RRuO	102	A	38	649	649	143
		Water Resources Div., Christian Party	RRuO	595	RRuO	103	A	32	649	649	81
		PWD Rural Div Office Complex,	RRuO	597	RRuO	82	A	30	418	418	137
		Sibasagar Office Building	RRuO	537	RRuO	107	A	33	399	399	84
		Usha Lodge, near ONGCL Colony	RRuO	604	RRuO	24	IA	20	195	195	83
		Janiganji Govt. Boys HS School	RRuO	607	RRuO	11	IA	87	288	288	65
		Office Building of RLO, Ithkola Market	RRuO	567	RRuO	92	A	37	376	376	64
		Tezpur Office Building	RRuO	536	RRuO	104	A	24	606	606	61
Bihar		Digboi Carbon factory Campus, Borguri	RRuO	594	RRuO	99	A	22	252	252	95
		Coal India Office Complex, Margherita	RRuO	586	RRuO	97	A	22	352	352	61
		Shreepuria, Borguri	RRuO	605	RRuO	43	IA	34	323	323	61
		Beltron Bhawan, Shastry Nagar	RRuO	210	RRuO	88	A	82	883	883	61
		Gandhi Maidan Test Centre	RRuO	284	RRuO	52	A	137	1526	1526	61
		Modern Foods, Industrial Area	RRuO	106	RRuO	148	A	65	1129	1129	61
		Sector-17 C	RRuO	263	RRuO	150	A	42	709	709	61
		Punjab Engineering College, Sector 12	RRuO	264	RRuO	153	A	31	641	641	61
		Sector-39, IMTECH	RRuO	463	RRuO	150	A	41	563	563	61
		Kaimbwala Village	RRuO	464	RRuO	146	A	38	664	664	61
Chhattisgarh		Visak Hostel, Sector-4	RRuO	65	RRuO	93	A	156	200	200	61
		R.O., 5/32 Banglow Office Building	RRuO	67	RRuO	94	A	116	184	184	61
		M.P. Laghu Udyog Nigam	RRuO	245	RRuO	88	A	163	296	296	61
		RO, CECB Vyapar Vihar	RRuO	364	RRuO	35	IA	170	645	645	61
		HIG 21,22,Near Ghantaghari;	RRuO	249	RRuO	93	A	114	281	281	61
		Pragati Nagar NTPC Colony	RRuO	407	RRuO	95	A	109	243	243	61
		I.T.I., Ranchi	RRuO	368	RRuO	46	IA	262	532	532	61
		New HIG-9, Hirapur	RRuO	223	RRuO	53	A	382	642	642	61
		M/S Wool Worth India, Sarora Raipur	RRuO	447	RRuO	50	A	273	471	471	61
		Yatayat Thana, Jai Stambh Chowk	RRuO	558	RRuO	94	A	37	290	290	61
Delhi		Khadoli Industrial Area, Village- Khadoli	RRuO	560	RRuO	96	A	32	254	254	79
		Daman	RRuO	144	RRuO	91	A	53	1045	1045	79
		Kadaiya Industrial Area, Village- Kadaiya	RRuO	146	RRuO	93	A	94	1127	1127	79
		N.Y. School, Sarojini Nagar	RRuO	345	RRuO	96	A	102	1039	1039	79
		Town Hall, Chandni Chowk	RRuO	531	RRuO	79	A	124	959	959	79
		Mayapuri Industrial Area	RRuO	58	RRuO	77	A	95	1090	1090	79
		Pritampura	RRuO	57	RRuO	79	A	137	1132	1132	79
		Shahdara Bagh	RRuO	55	RRuO	80	A	104	853	853	79
		Nizamuddin	RRuO	59	RRuO	72	A	141	860	860	79
		Janakpuri	RRuO	60	RRuO	79	A	73	766	766	79
Sikkim		Siri Fort	RRuO	71	RRuO	73	A	73	448	448	71

State	City	Location	Type	Category of ES	No. of mon. days (n)	A/IA	Min	Max	Std. Dev.
									SPM Annual average ( $\mu\text{g}/\text{m}^3$ )
Delhi	Delhi	N.Y. School, Sarojini Nagar Town Hall, Chandni Chowk	RIRUO	91	A	53	1045	426	224
		Mayapuri Industrial Area	RIRUO	93	A	94	1127	560	239
		Pritampura	RIRUO	96	A	102	1039	576	228
		Shahadra	RIRUO	79	A	124	959	444	172
		Shahzada Bagh	RIRUO	77	A	95	1090	501	207
	Goa	Nizamuddin	RIRUO	79	A	137	1132	527	190
		Ianakpuri	RIRUO	80	A	104	853	456	164
		Siri Fort	RIRUO	72	A	141	860	511	161
		Panaji	RIRUO	79	A	73	766	448	171
		Old GSPCB premises, Patto	RIRUO	105	A	39	332	134	60
Gujarat	Ahmedabad	Fire Brigade Station, Port Trust	RIRUO	118	A	15	310	103	48
		Fuse Call Office of Elec. Dept., Mormugao taluka	RIRUO	103	A	38	319	119	64
		Naroda, G.I.D.C., Ahmadabad	RIRUO	157	A	611	180	383	104
		Cadilla Bridge Narol	RIRUO	103	A	108	257	190	28
		L.D. Engg. College	RIRUO	104	A	84	198	147	25
	Surat	Shardaben Hospital, Saraspur	RIRUO	103	A	114	243	182	34
		R.C. High School, Mirzapur	RIRUO	104	A	108	253	189	30
		Naroda, G.I.D.C.,	RIRUO	104	A	125	243	184	27
		Rallis India Ltd.	RIRUO	104	A	110	219	170	27
		Durga Traders, Bhavanafarm Society	RIRUO	104	A	93	188	147	21
Haryana	Jammu and Kashmir	Fisheries Office	RIRUO	104	A	149	281	195	16
		Sardhara Industrial Corporation	RIRUO	104	A	64	306	208	40
		Regional Office	RIRUO	104	A	87	297	142	32
		S.V.R. Engg. College	RIRUO	104	A	83	197	151	23
		B.R.C. High School, Udhna	RIRUO	24	IA	131	242	179	114
	Punjab	Air India Office	RIRUO	104	A	122	226	164	21
		GPCB Office, Gери Vasahat	RIRUO	96	A	69	167	111	19
		Dandia Bazaar	RIRUO	96	A	134	320	210	34
		CETP Nandedari	RIRUO	96	A	201	402	322	36
		GEB, IInd Phase, GIDC, Vapi	RIRUO	104	A	124	219	178	21
Himachal Pradesh	Haryana	Vapi Nagar Palika, Vapi	RIRUO	104	A	108	201	154	20
		Escorts Research Centre Mathura Road	RIRUO	145	A	81	110	95	7
		RO Haryana SPCB	RIRUO	96	A	362	469	397	24
		Urban Estate - II	RIRUO	27	IA	118	262	166	33
		Guru Nanak Dev University	RIRUO	52	A	104	2253	216	299
	Himachal Pradesh	Ballarpur Industries	RIRUO	52	A	105	636	361	121
		Industry Department Office Building	RIRUO	96	A	62	610	218	96
		AHC barotiwala	RIRUO	85	A	66	494	208	84
		Housing Board	RIRUO	11	IA	123	270	197	49
		Regional Office	RIRUO	150	A	72	268	137	40
Himachal Pradesh	Himachal Pradesh	Old Road	RIRUO	114	A	77	261	160	36

State	City	Location	Category of ES	No. of mon. days (n)	A/IA	Min	Max	Std. Dev.	SPM Annual average ( $\mu\text{g}/\text{m}^3$ )
						156	106	892	396
						157	48	372	181
Jammu & Kashmir	Kala Amb	Kala Amb Industrial Area	Category of ES Industrial	No. of mon. days (n)	A/IA	67	A	537	189
	Trilokpur	RIRuo				61	A	32	385
	Nalagarh	RIRuo				78	A	44	385
	Municipal Council	RIRuo				140	A	89	405
	Regional Office, Sector- 4	RIRuo				117	A	106	594
	Asst. Commissioner Building, Sector I	RIRuo				132	A	14	284
	Paonta Sahib	RIRuo				118	A	119	94
	Gondhpur Industrial Area	RIRuo				34	ES	140	286
	Tekka Bench Ridge	RIRuo				35	ES	122	103
	Bus Stand, Winterfield	RIRuo				184	Hill station	40	309
Haryana	Regional Office, Jammu	RIRuo	Category of ES Commercial	No. of mon. days (n)	A/IA	88	A	79	258
	M.A. Stadium, Javel Chowk, Jammu	RIRuo				482	RIRuo	85	A
	Bari Brahma Industrial Area, Jammu	RIRuo				507	RIRuo	78	275
	EMTI, Bastacola	RIRuo				612	RIRuo	49	166
	CGM Office, Kusunda	RIRuo				611	RIRuo	83	40
	R.O. Dhanbad	RIRuo				44	RIRuo	49	443
	Bistupur Vehical Testing Centre	RIRuo				351	RIRuo	89	179
	Golmuri Vehicle Testing Centre	RIRuo				382	RIRuo	91	410
	M.A.D.A.	RIRuo				332	RIRuo	46	229
	Ranchi	RIRuo				402	RIRuo	111	192
Jharkhand	Albert Elkka Chowk, Main Road	RIRuo	Category of ES Residential	No. of mon. days (n)	A/IA	111	A	192	787
	Saraikela Khar-sawan	RO Building, Adityapur				614	RIRuo	86	292
	Sindri	BIT / PDIL				46	RIRuo	37	197
	West Singhbhum	Barajamda U.M. Office				615	RIRuo	84	174
	Graphite India	RIRuo				77	RIRuo	72	472
	Yeshwanthpura police station	RIRuo				457	RIRuo	81	277
	Peenya Industrial Area	RIRuo				405	RIRuo	162	474
	KHB Industrial Area, Yelahanka	RIRuo				404	RIRuo	83	280
	AMCO Batteries, Mysore Road	RIRuo				78	RIRuo	49	65
	Jnanabharathi , Bangalore University	RIRuo				598	RIRuo	91	433
Karnataka	R V College of Engineering	RIRuo	Category of ES Educational	No. of mon. days (n)	A/IA	589	RIRuo	22	302
	TERI office, Vital Medi healthcare Pvt.Ltd	RIRuo				406	RIRuo	111	71
	Victoria hospital	RIRuo				460	ES	29	390
	Karnataka SPCB Office Building	Salyadri				459	RIRuo	10	105
	Government Hospital	RIRuo				458	RIRuo	107	400
	KSRTC bus stand building	RIRuo				432	RIRuo	84	45
	Lakamanahalli Industrial Area, Dharawad	RIRuo				431	RIRuo	95	45
	Rani Chennamma Circle, Hubli	RIRuo				488	RIRuo	105	45
	Stides Premises, Balkampady Industrial Area	RIRuo				40	RIRuo	94	45
	K.R.Circle	RIRuo				328	RIRuo	117	45
Mysore	KSPCB Bldg., Hebbal Ind. Area	RIRuo	Category of ES Commercial	No. of mon. days (n)	A/IA	27	RIRuo	143	78
	Government Hospital	RIRuo				460	ES	193	78
	Hubli-Dharwad	RIRuo				459	RIRuo	400	47
	Mangalore	RIRuo				458	RIRuo	301	93
	Mysore	RIRuo				432	RIRuo	94	93
	KSPCB Bldg., Hebbal Ind. Area	RIRuo				40	RIRuo	27	26
	Government Hospital	RIRuo				460	ES	193	78
	Hubli-Dharwad	RIRuo				459	RIRuo	400	47
	Mangalore	RIRuo				458	RIRuo	301	93
	Mysore	RIRuo				432	RIRuo	94	93

State	City	Location	Type	Category of ES	No. of mon. days (n)	A/IA	Min	Max	Std. Dev.	SPM Annual average ( $\mu\text{g}/\text{m}^3$ )
										618
										617
Kerala	Alappuzha	District Office, Alissery Road DC Mills, Pathirappally	RIRuo	120	A	20	212	71	34	149
	Eloor I	Eloor I	RIRuo	90	A	24	306	65	40	29
	Eloor II	Eloor II	RIRuo	91	A	27	237	83	39	30
	Ernakulam	Ernakulam South	RIRuo	109	A	18	147	50	29	338
	VYTILA	VYTILA	RIRuo	109	A	22	118	53	23	562
	MG Road Bank Ernakulam	MG Road Bank Ernakulam	RIRuo	108	A	20	123	57	26	147
	Kalamassery	Kalamassery	RIRuo	108	A	21	130	52	24	346
	KSPCB	KSPCB, District Office, Kadappakkada	RIRuo	117	A	43	275	107	42	621
	KMML	KMML Chavara	RIRuo	56	A	22	132	54	24	620
	Kottayam	Kottayam	RIRuo	96	A	50	63	57	3	187
Madhya Pradesh	Kozhikode	Vadavathoor	RIRuo	96	A	35	53	43	6	361
	Malapuram	Kozhikode City	RIRuo	108	A	55	115	80	15	360
	Palakkad	Nallalam	RIRuo	108	A	49	115	85	15	359
	Pathanamthitta	Kakkancherry Sijmak oils	RIRuo	108	A	27	70	43	7	623
	Thissur	SEFR Retractories India Ltd. Near District Office KSPCB, Makkamkunnu	RIRuo	120	A	22	64	42	8	311
	Wayanad	KSPCB, District Office, Poonkunnam	RIRuo	93	A	37	284	82	49	619
	Sulthan Bathery	Sulthan Bathery	RIRuo	119	A	54	94	70	8	622
	PRSI Hospital/COSMO	PRSI Hospital/COSMO	RIRuo	108	A	46	73	59	6	419
	Trivandrum	SMV School VELI	RIRuo	109	A	39	305	65	25	181
	PETTAH	PETTAH	RIRuo	106	A	43	110	77	14	357
MP	Bhopal	Hamidia Road, M.P. Hastship Vikas Nigam C E T P Govindpura	RIRuo	107	A	43	85	57	6	358
	CETP	EID Perry (I) Limited	RIRuo	73	A	80	803	363	171	122
	Dewas	Dewas Metal Section	RIRuo	74	A	41	753	277	158	123
	Gwalior	Vikas Nagar	RIRuo	88	A	68	66	255	420	525
	Dindayal Nagar	Dindayal Nagar	RIRuo	58	A	278	57	173	58	479
	Nagda	Maharaj Bada	RIRuo	88	A	455	85	203	71	478
	Indore	Polo Ground	RIRuo	75	A	715	172	474	131	75
	Jabalpur	Kothari Market, M.G. Road Telephone Nagar, Kanadia Road	RIRuo	79	A	59	628	256	103	128
	Sagar	Vijay Nagar	RIRuo	87	A	132	580	278	98	131
	Satna	B C Labour Club	RIRuo	81	A	84	408	214	63	248
Ujjain	Nagda	Grasim Kalyan Kendra	RIRuo	21	A	337	250	294	21	84
	Sagar	Pt. Deendayal Nagar, Housing Board Colony	RIRuo	72	A	48	108	268	100	532
	Satna	Sub-divisional Office E/M Light Machinery	RIRuo	80	A	622	104	359	109	343
	Singrauli	Regional Office MPPCB	RIRuo	96	A	509	106	185	78	342
	Wardhan	Jayant Township	RIRuo	13	A	420	317	374	33	515
	Wardhan	N.T.P.C., Vidyanagar	RIRuo	19	A	297	213	270	22	514
	Ujjain	District Office Regional Office	RIRuo	13	A	174	135	157	12	516
		Mahakal Temple	RIRuo	74	A	376	117	244	58	526
			RIRuo	48	A	193	62	113	27	528
			RIRuo	59	A	219	83	146	33	59

State	City	Location	Type	Category of ES	No. of mon. days (n)	A/IA	Min	Max	Std. Dev.	
									SPM Annual average ( $\mu\text{g}/\text{m}^3$ )	
									95	
Aurangabad	S.B.E.S. College Collector Office C.A.D.A. Office, Garkheda	511 512 513	RIRuo RIRuo RIRuo	111 108 103	A A A	103 60 67	478 286 306	266 169 170	46	
Badlapur	BIWA Office Grampandhat Ghughus MIDC Chandrapur	649 267 281	RIRuo RIRuo RIRuo	92 93 96	A A A	37 66 156	299 1733 924	141 364 428	66 364 164	
Chandrapur	Nagar Parishad Gadchandur Gram Panchayat, Rajura MIDC, Tadali	396 640 638	RIRuo RIRuo RIRuo	97 74 54	A A A	44 42 89	1017 1284 1617	233 329 623	144 241 408	
Jalgaon	Municipal Council, Ballarshah B.J. Market Girna water tank MIDC Jalgaon	639 644 645 646	RIRuo RIRuo RIRuo RIRuo	94 69 68 70	A A A A	25 131 120 133	1203 291 262 86	385 191 195 134	207 37 33 10	
Kolhapur	University Campus, Shivaji University Ruikar Trust, Dabholkar Corner, ST Stand Mahadwari Road, Near Mahalaxmi Temple	508 509 510	ES ES ES	Sahyadri Sahyadri Sahyadri	101 92 102	A A A	86 169 142	1617 436 306	113 290 266	10 55 39
Latur	MIDC Water Works Terrace of Kshewrai Vidyalaya Shyamnagar Terrace of Sidhheshwar Sahakari Bank Ganigodai MIDC Chalkewadi	641 642 643 489	RIRuo RIRuo RIRuo RIRuo	99 104 61 12	A A A A	51 91 116 144	334 622 765 341	179 297 253 215	67 108 104 54	
Lote	Pump House, CETP Water treatment plant, Bhirwadi EHS, M/s Privi organics Ltd	490 569 570	RIRuo RIRuo RIRuo	18 66 56	A A A	68 65 46	410 384 281	193 164 148	88 62 53	
Mahad	Mahatma Phule Hall, MNP	571	RIRuo	50	A	63	343	156	77	
Mumbai	Kalbadevi Parel, Ambedkar Road Worli	169 170 349	RIRuo RIRuo RIRuo	84 98 89	A A A	52 70 57	421 568 323	206 246 176	95 110 62	
Nagpur	Institution of Engineers Govt. Polytechnic College, Sadar MIDC Office Hingana Road MIDC Industrial Area, MIDC Office, Hingna Maskasath, Itwari NEERI Lab, Nehru Marg	287 314 288 165 166 167	RIRuo RIRuo RIRuo RIRuo RIRuo RIRuo	87 88 83 55 73 61	A A A A A A	73 68 45 73 39 40	384 398 367 486 691 457	141 135 164 239 226 128	51 51 71 102 51 68	
Nashik	R.T.O. Colony Tank VIP Industrial Area, MIDC Satpura Nashik Municipal Council Building T.B.I.A. Rabale , Airoli, TTC	259 269 280 491	RIRuo RIRuo RIRuo RIRuo	112 113 111 102	A A A A	28 31 29 35	355 366 380 582	145 140 150 203	75 78 87 100	
Navi Mumbai	Dr. D.Y. Patil College, Nerul, TTC MPCB Central Lab, Mhape CIDCO Nodal Office Kharghar Panvel Residential Area, Taloja MIDC Collom Facility Building	492 493 494 495 496	RIRuo RIRuo RIRuo RIRuo RIRuo	96 61 105 96 99	A A A A A	37 459 38 641 112	710 459 509 641 821	180 226 192 195 497	100 93 90 106 182	

Maharashtra

State	City	Location	Type	Category of ES	No. of mon. days (n)	A/IA	Min	Max	Std. Dev.	SPM Annual average ( $\mu\text{g}/\text{m}^3$ )		
							M					
							M	S				
Pune		Maratha Chamber of commerce, Bhosari State Electricity Board BLDG Nalstop Swargate Police Chawki	RIRuo		192	A	104	45	104	57		
Roha		Roha Industrial Association office Filter House of MIDC Water works Udyog bhavan / SRO, MPCB Sangli Sangli- Mirai Primary school Building	RIRuo		105	A	41	495	204	104		
Sangli		Krishna Valley School	RIRuo		64	A	34	420	203	108		
Solapur		WIT Campus Voronoko School / Chitale Clinic	RIRuo		160	A	67	301	152	44		
Thane		Maternity Hospital,Dhobighat,Kopri Terrace of Shahru Market,Naupada	RIRuo		105	A	61	68	249	39		
Thane		Kolshet and Balkum, Thane West	RIRuo		104	A	21	150	79	33		
Ulhasnagar		Smt. C. H. M. College Campus Octroi Naka	RIRuo		104	A	32	212	92	43		
Aizawl		Khatla, M.G-Road, Roof Top of Mizoram SPCB Laipuitlang, Residence of Chairman, MPCB	ES	Hill station	104	A	117	74	80	4		
Aizawl		Bawngkawn , Roof Top of Mr.K.L. Berema's residence	ES	Hill station	20	IA	37	71	90	5		
Aizawl		Smt. C. H. M. College Campus	RIRuo		99	A	45	229	120	43		
Mizoram		Dimapur	RIRuo		94	A	61	338	148	55		
Nagaland		Kohima	ES	Hill station	93	A	19	287	135	74		
		Opposite War Cemetery	RIRuo		93	A	23	318	140	71		
		Industrial Estate	RIRuo		51	A	63	176	100	23		
		NALCO Township	ES	Hill station	42	IA	41	292	155	86		
		Balasore	RIRuo		118	A	75	446	295	95		
		Berhampur	RIRuo		100	A	65	414	149	45		
		Angul	RIRuo		100	A	84	206	160	32		
		Orissa	RIRuo		95	A	62	396	143	56		
		Bhubaneswar	RIRuo		105	A	65	547	172	95		
		Rayagada	RIRuo		98	A	42	343	148	59		
		Cuttack	RIRuo		113	A	65	418	179	71		
		Sambalpur	RIRuo		105	A	99	445	231	80		
		Talcher	RIRuo		104	A	172	247	208	15		
			RIRuo		84	A	95	165	131	15		
			RIRuo		66	A	123	438	277	69		
			RIRuo		103	A	84	363	203	55		

State	City	Location	Type	Category of ES	No. of mon. days (n)	A/IA	Min	Max	Std. Dev.
									SPM Annual average ( $\mu\text{g}/\text{m}^3$ )
Punjab	Dera Bassi	M/s Winsome Yarns Ltd., Barwala Road, Dera bassi	RIRuo	505	51	A	208	330	264
	Naya Nangal	M/s NFL Guest House	RIRuo	421	45	IA	132	191	158
	Patiala	Ceylon Industries	RIRuo	600	50	A	148	260	202
		Fire Brigade Station, Bahera Road,	RIRuo	599	50	A	162	235	194
		DSTC Office Upstairs, Anna Nagar	RIRuo	64	90	A	30	94	60
	Puducherry	PIPDIC Ind. Estate Mettupalyam	RIRuo	93	82	A	36	123	70
Alwar		Chamber Of Commerce	RIRuo	337	83	A	23	71	45
		Regional Office, Rajasthan SPCB	ES	372	82	A	54	1953	403
		Gaurav Solvex Ltd, MIA	ES	373	75	A	48	1483	520
		RICO Pump House, MIA	ES	219	72	A	87	961	281
		Aimeri Gate	RIRuo	296	1	IA	47	1190	345
		RIPB Office, Jhalana Doongari	RIRuo	298	108	A	23	1056	235
Jaipur		Office of District Education Officer, Chandpole	RIRuo	408	92	A	153	1076	488
		RICO Office, M.I.A.	RIRuo	410	102	A	42	1399	249
		Regional Office (North), RSPCB, Vidyadhar Nagar	RIRuo	409	109	A	74	2485	474
		VKA	RIRuo	297	114	A	98	2015	547
		DIC Office, Industrial Estate	RIRuo	413	96	A	78	992	348
		Sojati Gate	RIRuo	273	103	A	106	1180	453
Jodhpur		Basni Industrial Area, RICO Office	RIRuo	274	97	A	125	1300	422
		Maha Mandir Police Thane	RIRuo	376	99	A	78	1235	451
		Office of Housing Board, Chopasani Road	RIRuo	411	98	A	73	1058	342
		Shastri Nagar Police Thana	RIRuo	412	102	A	72	1210	418
		Regional Office, RIPB, Anantpura	RIRuo	17	102	A	38	886	287
		Municipal Corporation Building	RIRuo	326	101	A	37	688	230
Kota		Samcore Glass Ltd.	RIRuo	325	103	A	31	552	214
		Ambamata	RIRuo	320	92	A	130	493	284
		Town Hall	RIRuo	294	93	A	132	660	313
		Regional Office, MIA	RIRuo	321	83	A	166	807	407
		Kathivakkam, Municipal Kalyana Mandapam	RIRuo	38	100	A	63	335	174
		Govt. High School, Manali	RIRuo	71	102	A	47	407	161
Chennai		Thiruvottiyur	RIRuo	72	93	A	72	362	165
		Madras Medical College	RIRuo	159	88	A	39	204	99
		NEERI, CSIR Campus	RIRuo	160	95	A	29	158	83
		Thiruvottiyur Municipal Office	RIRuo	161	95	A	24	258	99
		Poniaraiapuram, On the top of DEL	RIRuo	371	81	A	21	206	100
		G.D. Matric Hr.Sec.School	RIRuo	238	100	A	34	506	140
Coimbatore		SIDCO Office Kurichi	RIRuo	237	93	A	77	1403	262
		Highway (Project -I) Building	RIRuo	306	103	A	52	226	111
		Fenner (I) Ltd. Susee Cars & Trucks	RIRuo	307	93	A	54	166	94
		Kunnathur Chatram Girls HS School	RIRuo	308	97	A	64	267	120
		Sowdeswari College Building	RIRuo	309	118	A	52	267	120
		Fisheries College	RIRuo	239	78	A	38	586	143
Tamilnadu		Raja Agencies	RIRuo	240	90	A	72	724	289

State	City	Location	Category of ES	No. of mon. days (n)	A/IA	Min	Max	Std. Dev.	
Agra		Regional Office, Bodla Nunhai	323	ES	Taj-trapezium	89	A	181	511
		Taj Mahal	324	ES	Taj-trapezium	96	A	169	583
		DIC Nunhai	1	ES	Taj-trapezium	283	A	24	1046
		Etmad-uddaulah Rambagh	415	ES	Taj-trapezium	123	A	65	1194
		Square crossing circle of Laxmi Talkies	416	ES	Taj-trapezium	122	A	64	523
		Bharat Yantra Nigam Ltd	417	ES	Taj-trapezium	116	A	60	889
		Anpara Colony, Sonabhadra	554	RIRuO		105	A	229	1144
		Renusagar Colony, Sonabhadra	555	RIRuO		105	A	154	739
		Center for Development of Glass Industry ( CDGI )	6	RIRuO		104	A	168	377
		Tiak Nagar	7	RIRuO		96	A	152	312
Ferozabad		Raza ka Tal	399	ES	Taj-trapezium	104	A	98	638
		Raunaq Auto Lrd., J.P. Nagar	400	ES	Taj-trapezium	103	A	94	620
		Indira Chowk, J.P. Nagar	401	ES	Taj-trapezium	101	A	65	424
		M/s Atlas Cycles Industries Ltd, Sahibabad Industrial Area	140	RIRuO		88	A	202	606
		Gajraula	139	RIRuO		68	A	150	596
		Ghaziabad	258	RIRuO		97	A	330	205
		Bulandshaar Road Industrial Area	369	RIRuO		88	A	308	596
		Jhansi	517	RIRuO		120	A	199	405
		Jail Chauraha	518	RIRuO		120	A	144	596
		Veeranga Nagar	212	RIRuO		98	A	271	455
Kanpur		Forest & Training Centre, Kidwai Nagar	98	RIRuO		91	A	355	455
		Chamber Of Commerce, Darshapurwa	86	RIRuO		81	A	288	677
		Fazalganj	391	RIRuO		80	A	303	582
		Dabauli	395	RIRuO		93	A	305	582
		Awas Vikas, Jajmau	534	RIRuO		58	A	260	559
		Central Glass & Ceramic Research Institute	535	RIRuO		58	A	162	309
		Ahirpara	377	RIRuO		74	A	277	305
		Mahanagar	398	RIRuO		109	A	288	477
		Chandganj Garden, Aliganj	109	RIRuO		82	A	275	478
		Kapoorn Hotel, Hazratganj	113	RIRuO		81	A	296	542
Lucknow		Talkatora	397	RIRuO		101	A	303	524
		S.M.K Chowk, Aminabad	550	RIRuO		66	A	415	390
		Begum Bridge	551	RIRuO		42	A	320	490
Meerut		Thana Railway Road, Kesarganj							

Uttar Pradesh

State	City	Location	Category of ES	Type	Station code	SPM Annual average ( $\mu\text{g}/\text{m}^3$ )			Std. Dev.	
						Max		Min		
						A/IA	Max			
			No. of mon. days (n)							
Muradabad	Budh Bazar PTC	RIRR0	28	IA	59	758	310	153		
Noida	Regional Office, UP PCB Gee-Pee Electroplating and Engineering Work	RIRR0	403	IA	42	632	220	127		
Varanasi	Regional Office, Jawahar Nagar Sigra	RIRR0	378	IA	95	147	652	438	94	
Dehradun	Raipur Road, Near patrag Diary Clock Tower, PWD Guest House	RIRR0	362	IA	96	198	694	442	96	
Haldwani	Himalaya Drug Co. Near ISBT Govt. Women Hospital	RIRR0	553	IA	24	377	412	398	10	
Haridwar	SIDCUL, Haridwar	RIRR0	90	ES	Doon valley	30	IA	178	396	
Kashipur	BSNL Office, Kashipur	RIRR0	89	ES	Doon valley	50	IA	180	369	
Rishikesh	Nagar Palika Parishad Asansol Municipal Corporation	RIRR0	637	ES	Doon valley	3	IA	344	521	
Asansol	Kangabati Spinning Mill, Barjora Burmpur Town Department, Burmpur	RIRR0	625	ES	Doon valley	1	IA	178	454	
Barrackpore	Barrackpore Municipality Dum Dum Telephone Exchange	RIRR0	635	ES	Hill station	3	IA	232	273	
Durgapur	Khardah Municipality DMC Water Works, Angadpur	RIRR0	654	ES	Hill station	3	IA	481	521	
Haldia	Kwality Hotel, Bhiringi More, Benachiti Bidhannagar, PCBL Club, Muchipara	RIRR0	591	ES	Hill station	105	IA	56	495	
WBII/DC Durgachak	Dew India Limited, PCBL More, Durgapur Bhabanipur, Debhog Milan Viyapith	RIRR0	384	ES	Hill station	105	IA	81	287	
Howrah	Driver's Hut of M/s. MCC PTA, Bhunia Raichak Supermarket Building, Durgachak	RIRR0	385	ES	Hill station	105	IA	67	174	
Naskarpura Pump House, Ghuseri	WBII/DC Durgachak	RIRR0	14	ES	Hill station	105	IA	747	297	
Howrah	Howrah Municipal Corporation Building	RIRR0	8	ES	Hill station	105	IA	901	325	
Kolkata	Moulali, Rooftop of KMC office Building Minto Park, Inside Park-AJC Bose Road	RIRR0	10	ES	Hill station	105	IA	59	219	
	Salt Lake, Rooftop of CK Market	RIRR0	474	ES	Hill station	108	IA	70	250	
	Dunlop Bridge, National Sample Survey Building	RIRR0	473	ES	Hill station	108	IA	81	253	
	Behala Chowrasta, Traffic Guard Building	RIRR0	476	ES	Hill station	103	IA	81	114	

West Bengal

Category of ES	Type	Station code	Location	Std. Dev.				
				SPM Annual average ( $\mu\text{g}/\text{m}^3$ )	Max	Min	A/IA	No. of mon. days (n)
Raniganj	Jamuria Municipality	163	RIRuO		96	A	71	807
		348	RIRuO		96	A	28	883
		662	RIRuO		105	A	93	989
		660	RIRuO		104	A	83	765
		661	RIRuO		105	A	59	704
	Bharat Co-operative Housing Society	657	RIRuO		104	A	41	410
		659	RIRuO		104	A	44	513
		656	RIRuO		104	A	38	453
	Sankrail	658	RIRuO		104	A	33	372
		652	RIRuO		102	A	39	494
South Suburban	Balipur Police Station, Balipur	650	RIRuO		105	A	44	578
	P Roy Industrial Training Institute, Amtala	651	RIRuO		103	A	43	493

Note: RIRuO – Residential/industrial/rural/other area, ES – Ecologically sensitive area, mon- monitoring Std dev. – Standard deviation, n – number of days monitored for 16 and more hours a day  
 BDL = Below Detection Limit (Concentration less than  $5 \mu\text{g}/\text{m}^3$  for SPM).

A metropolitan area is a region consisting of a populous urban core with an agglomeration of peripheral zones not themselves necessarily urban in character, but closely bound to the center socio-economically by employment or commerce. It is characterized by urbanization which is a process of human movement and centralization towards and into cities and urban areas with the associated industrialization, urban sprawl and lifestyle. Urbanization in India is more rapid around the major cities in India. The population growth has been mainly centered around cities due primarily to the large scale migration of rural population accelerated by high population growth rates. Increase in industrial activities, population both endemic and floating and vehicular population etc. have led to a rapid increase in environmental problems, one of them being air pollution.

An inventory of air pollutants is a necessary first step towards control of air pollution. Air pollutants can be natural or may be the result of various anthropogenic activities like industrial emissions. Further the air pollutants can be primary or secondary depending upon their formation mechanism. Primary pollutants are directly emitted from the source and secondary pollutants are formed in the atmosphere. Meteorological factors play a critical role in ambient concentrations of air pollutants. Even though the total discharge of air pollutants into the atmosphere may remain constant, the ambient concentrations of air pollutants may vary depending upon the meteorological conditions. Keeping all these factors in mind, an attempt is made to address the problem of air pollution in seventeen cities in India identified by Honorable Supreme Court as polluted cities. These include the metropolitan cities of India which has been classified by Census of India 2001 as metropolitan cities.

Ambient air quality monitoring is required to determine the existing quality of air, evaluation of the effectiveness of control programme and to identify areas in need of restoration and their prioritization.

This chapter gives an insight into the trends of air pollutants for  $\text{SO}_2$ ,  $\text{NO}_2$  and  $\text{PM}_{10}$  in the 35 metropolitan cities (population  $\geq 10$  lacs; Census 2001). An analysis of ten years data reveals a decreasing trend of  $\text{SO}_2$ . This may be attributed to various interventions that have taken place in recent years such as reduction in sulphur in diesel, use of cleaner fuel such as CNG in metro cities, change in domestic fuel from coal to LPG etc.  $\text{NO}_2$  concentration has remained more or less stable over the years despite increase in sources like vehicles. The reason for this may be various intervention measures that have taken place such as improvement in vehicle technology and other vehicular pollution control measures like alternate fuel etc.  $\text{PM}_{10}$  concentration shows fluctuating trend. Vehicular emission are a major source of  $\text{PM}_{10}$ . Increasing number of vehicles may be a reason for this trend. The other reasons being emission from gensets, small scale industries, biomass incineration, suspension of traffic dust, natural dust, commercial and domestic use of fuel etc.

## 7.1 Air Quality Monitoring Stations in Metropolitan Cities

There are 144 monitoring stations in 35 metropolitan cities. These are listed in Table 7.1

**Table 7.1 Details of the Air Quality Monitoring Stations in Metropolitan Cities**

Indian Zone	State	City	Total No. of Operating Stations
North Zone	Delhi (9)	Delhi	9
	Haryana (2)	Faridabad	2
	Punjab (6)	Amritsar	2
		Ludhiana	4
	Uttar Pradesh (23)	Agra	6
		Allahabad	2
		Kanpur	6
		Lucknow	5
		Meerut	2
		Varanasi	2
		Patna	2
East Zone	Bihar (2)	Dhanbad	1
		Jamshedpur	2
		Asansol	1
	West Bengal (11)	Kolkata	10
		Hyderabad	9
South Zone	Andhra Pradesh (19)	Vijayawada	2
		Visakhapatnam	8
		Bangalore	6
	Karnataka (6)	Kochi	7
		Chennai	6
	Tamilnadu (12)	Coimbatore	3
		Madurai	3
		Ahmedabad	6
West Zone	Gujarat (15)	Rajkot	2
		Surat	3
		Vadodara	4
		Pune	3
	Maharashtra (15)	Mumbai	3
		Nagpur	6
		Nashik	3
		Jaipur	6
Central Zone	Madhya Pradesh (8)	Bhopal	4
		Indore	3
		Jabalpur	1
5	15	35	144

NB. Figures within parentheses represent total number of monitoring stations in the state

## 7.2 Air quality in metropolitan cities during 2010

The analysis of air quality in metropolitan cities with respect to  $\text{SO}_2$  reveals all the cities except Jamshedpur and Pune are in the low category and all are within the prescribed standard. As for  $\text{NO}_2$ , 9 cities are in the low category, 20 cities are in the moderate category, 3 in high and 2 in critical category in the residential / industrial / rural / commercial areas. With respect to  $\text{PM}_{10}$ , 8 under high and 24 cities fall in the critical category (Table 6.2). Table 7.4 gives an insight to the annual average and categories of the metropolitan cities.

**Table 7.2: Number of metropolitan cities with low, moderate, high & critical air quality (residential/industrial/commercial/rural and sensitive)**

Category	Number of Metropolitan cities (population > 10 lacs)					
	Residential / industrial / rural / commercial areas			Ecologically sensitive area		
	$\text{SO}_2$	$\text{NO}_2$	$\text{PM}_{10}$	$\text{SO}_2$	$\text{NO}_2$	$\text{PM}_{10}$
Low	32	9	0	1	0	0
Moderate	2	20	2	0	1	0
High	0	3	8	0	0	0
Critical	0	2	24	0	0	1
<b>Total cities</b>	<b>34</b>	<b>34</b>	<b>34</b>	<b>1</b>	<b>1</b>	<b>1</b>

NB. Low, moderate, high, critical classification based on Pollution Level Classification, Chapter 2, Table 2.1.

Of the 35 metropolitan cities 5 (15%) and 32 (94%) cities exceed the NAAQS with respect to  $\text{NO}_2$  and  $\text{PM}_{10}$  in the residential / industrial / rural / commercial areas. None of the cities exceed the standard limit with respect to  $\text{SO}_2$  (Table 7.3)

**Table 7.3: Number of metropolitan cities exceeding the NAAQS (Based on annual average data)**

Category	Number of Metropolitan cities (population > 10 lacs)					
	Residential / industrial / rural / commercial areas			Ecologically sensitive area		
	$\text{SO}_2$	$\text{NO}_2$	$\text{PM}_{10}$	$\text{SO}_2$	$\text{NO}_2$	$\text{PM}_{10}$
Not exceeding NAAQS	34	29	2	1	1	0
Exceeding NAAQS	0	5	32	0	0	1
<b>Total cities</b>	<b>34</b>	<b>34</b>	<b>34</b>	<b>1</b>	<b>1</b>	<b>1</b>

**Table 7.4: Air quality of metropolitan in India (Based on annual average data)**

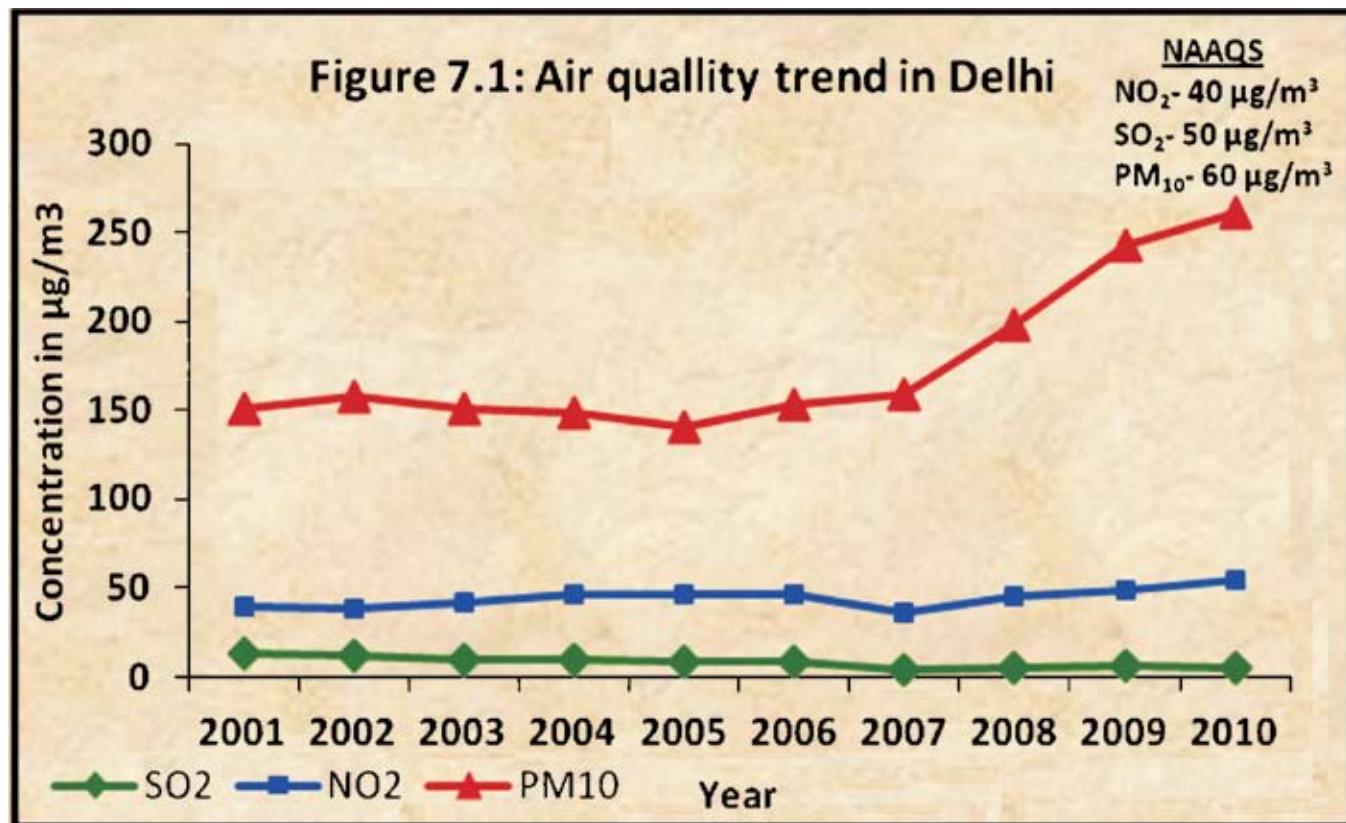
State	City	Type	SO <sub>2</sub>		NO <sub>2</sub>		PM <sub>10</sub>	
			Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality	Annual average ( $\mu\text{g}/\text{m}^3$ )	Air quality
Andhra Pradesh	Hyderabad	RIRuO	5	L	24	M	79*	H
	Vijaywada	RIRuO	6	L	14	L	93*	C
	Vishakhapatnam	RIRuO	7	L	16	L	71*	H
Bihar	Patna	RIRuO	7	L	40	M	181*	C
Delhi	Delhi	RIRuO	5	L	55*	H	261*	C
Gujarat	Ahmedabad	RIRuO	15	L	21	M	95*	C
	Rajkot	RIRuO	13	L	17	L	96*	C
	Surat	RIRuO	16	L	24	M	76*	H
	Vadodara	RIRuO	17	L	29	M	93*	C
Haryana	Faridabad	RIRuO	18	L	29	M	164*	C
Jharkhand	Dhanbad	RIRuO	15	L	36	M	184*	C
	Jamshedpur	RIRuO	35	M	48*	H	153*	C
Karnataka	Bangalore	RIRuO	14	L	31	M	89*	H
Kerala	Kochi	RIRuO	4	L	17	L	61*	H
Madhya Pradesh	Bhopal	RIRuO	9	L	18	L	133*	C
	Indore	RIRuO	14	L	18	L	120*	C
	Jabalpur	RIRuO	2	L	25	M	135*	C
Maharashtra	Mumbai	RIRuO	4	L	19	L	97*	C
	Nagpur	RIRuO	7	L	33	M	113*	C
	Nashik	RIRuO	21	L	26	M	76*	H
	Pune	RIRuO	29	M	39	M	82*	H
Punjab	Amritsar	RIRuO	14	L	36	M	219*	C
	Ludhiana	RIRuO	9	L	32	M	214*	C
Rajasthan	Jaipur	RIRuO	6	L	37	M	164*	C
Tamilnadu	Chennai	RIRuO	9	L	15	L	59	M
	Coimbatore	RIRuO	5	L	27	M	78*	H
	Madurai	RIRuO	11	L	25	M	47	M
Uttar Pradesh	Agra ES (Taj-trapezium)	RIRuO	5	L	20	M	185*	C
	Allahabad	RIRuO	4	L	24	M	218*	C
	Kanpur	RIRuO	7	L	34	M	203*	C
	Lucknow	RIRuO	8	L	34	M	204*	C
	Meerut	RIRuO	8	L	47*	H	166*	C
	Varanasi	RIRuO	18	L	20	L	127*	C
West Bengal	Asansol	RIRuO	8	L	66*	C	141*	C
	Kolkata	RIRuO	11	L	62*	C	99*	C

L: Low, M: Moderate, H: High, C: Critical \*Concentration exceeding NAAQS; Low, moderate, high, critical classification based on Pollution Level Classification, Chapter 2, Table 2.1, '-' inadequate data; Data of monitoring stations with monitoring days  $\geq 50$  has only been considered

### 7.3 Air quality trend in metropolitan cities

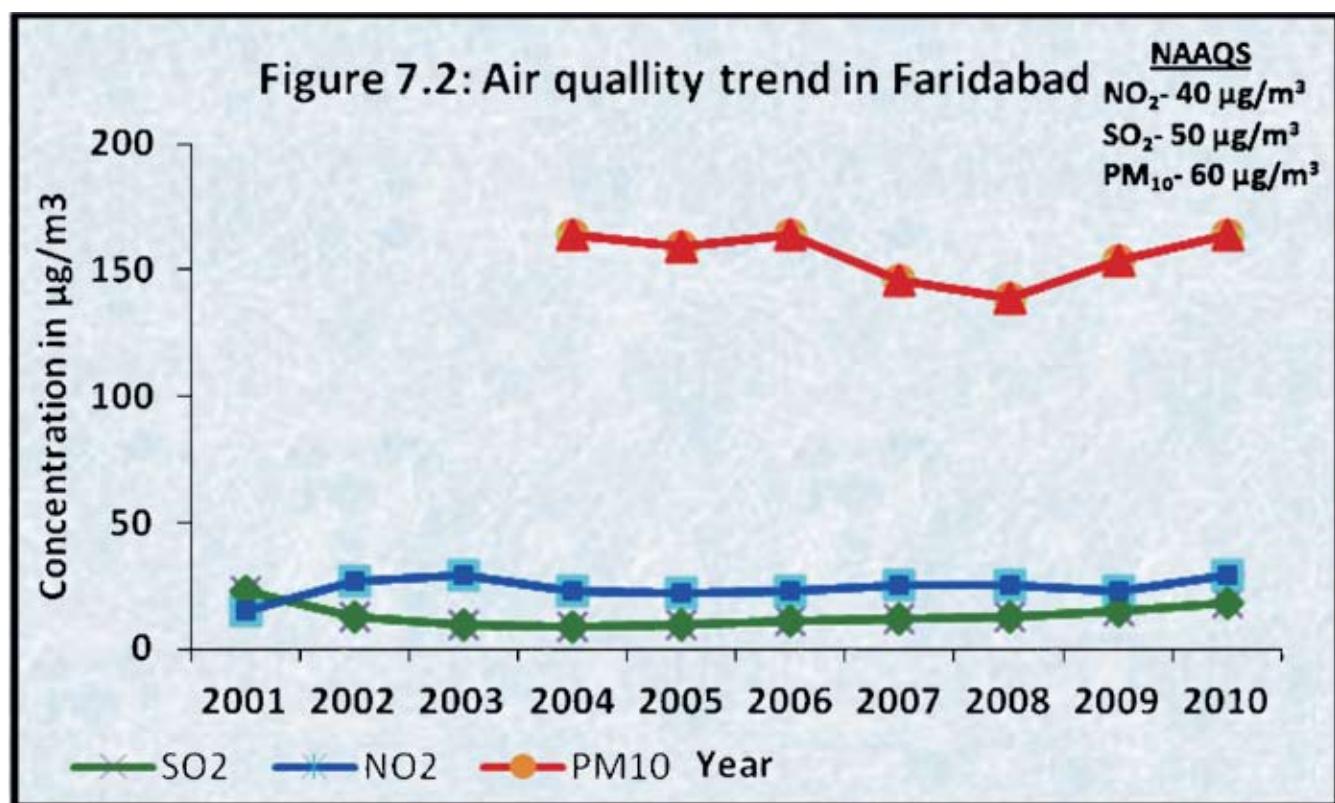
#### 7.3.1 DELHI – the capital city

State	Delhi, largest metropolis by area and the second-largest metropolis by population in India
Location	28°22'48"N and 77°7'12"E
Area	1,484 km <sup>2</sup> (573 sq mi) of which 783 km <sup>2</sup> (302 sq mi) is rural, and 700 km <sup>2</sup> (270 sq mi) urban. Maximum length 51.9 km (32 mi) and maximum width 48.48 km (30 mi).
Population	1,27,9,458 (as per Census 2001)
Climate	Humid subtropical. Summers are long and extremely hot (early April to mid-October). Monsoon winds advent from end of June. Reversal in the wind direction from the north-western direction to the south-western in early March brings hot waves (called loo) from Rajasthan. Winter starts in late November and peaks in January accompanied by heavy fog. Temperature: 45°C in summers to 4°C in winters Rainfall: Average annual rainfall is 714 mm (28.1 inches)
Geography	The river Yamuna flows through the city having huge catchment area distributed at both the banks. Mixed type of soil deposits. Quartz rock and extends from south part to west bank of the Yamuna River for about 35 km.
Industries	Engineering goods, textile, chemical, electronics, electrical goods, dyes and paints, steel, plastic, rubber, automobiles, thermal power stations (Badarpur thermal power station, Indraprastha thermal power station, Rajghat thermal power station and Gas turbine thermal power station)
Air quality stations	11 (3 residential, 8 industrial)
Air quality trend	Analysis of nine year air quality data shows an increasing trend for PM <sub>10</sub> , a decreasing trend for SO <sub>2</sub> and fluctuating for NO <sub>2</sub> (Figure 7.1). The increasing trend for PM <sub>10</sub> may be attributed to the increasing number of vehicles and natural dust.



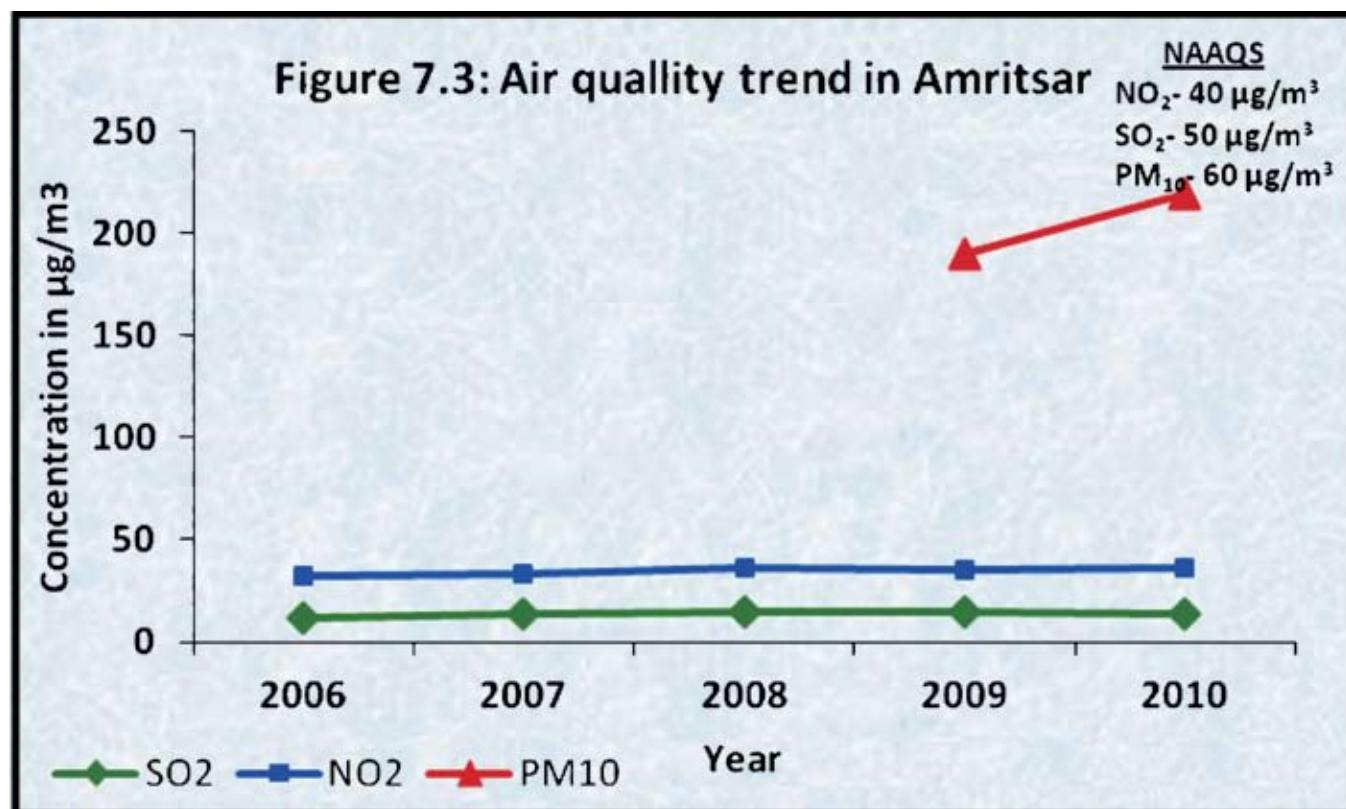
### 7.3.2 FARIDABAD

State	Haryana
Location	28° 15' N and 77° 13' 12" E
Area	216.4 km <sup>2</sup>
Population	10, 54, 981
Climate	Temperature: extreme conditions of summer and cold with maximum and minimum temperatures of 45 and 5°C respectively Rainfall: July to September with 562.9 mm
Geography	Alluvium and pre-combrian sediments systems. The stratigraphic units are windblown sands, newer alluvium, older alluvium, slates, phyllites, quartzites, mica sheets, pagamite intrusions, silts, gravel, sand, clay and kankar
Industries	Drugs & pharmaceuticals, plastics, metal casting, agriculture equipments, automobile parts, electricals, garments, Chemicals, petrochemicals, Gas & other engineering industries. 15,000 small, medium and large scale industries are in operation.
Air quality stations	2 (1 residential, 1 industrial)
Air quality trend	Analysis of nine year air quality data shows an increasing trend for PM <sub>10</sub> , a decreasing trend for SO <sub>2</sub> and a stable trend for NO <sub>2</sub> (Figure 7.2).



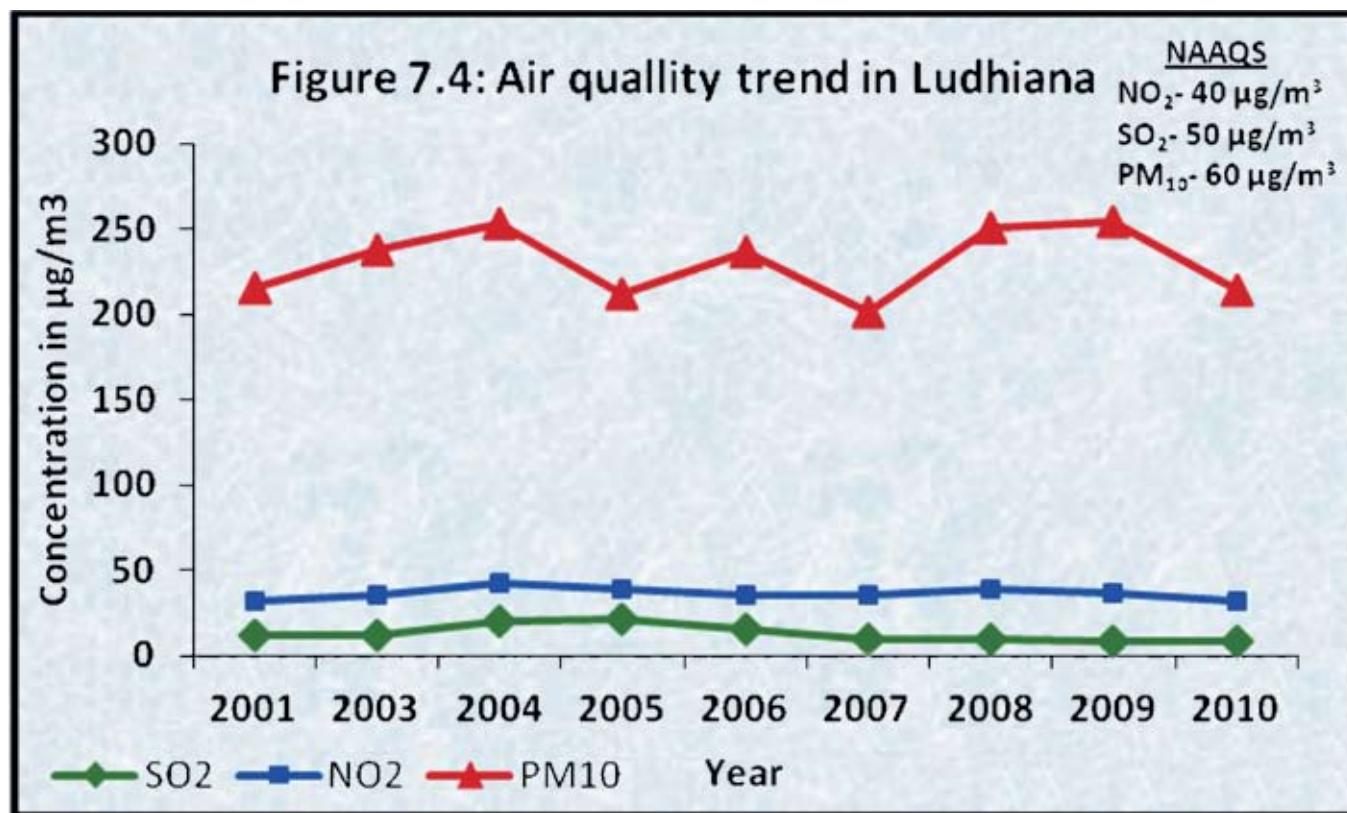
### 7.3.3 AMRITSAR

State	Punjab
Location	31°38' N and 74°52' E
Area	50 km <sup>2</sup>
Population	10, 11,327
Climate	Tropical type with three well defined seasons winter, summer and monsoon Rainfall: annual average normal rainfall is 700 mm
Geography	Alluvial deposits of quaternary age which are a part of Indus basin
Industries	Food, textile, readymade garments and tailoring, leather goods, wood based, paper, dying & chemical, detergent, medicine, machine, agriculture, electrical goods and appliances, surgical items, auto and cycle parts, floor mills, cold storages etc. The total number of small scale industries functioning is approximately 8000
Air quality stations	2 (2 residential)
Air quality trend	Analysis of four year air quality data shows a more or less stable trend for both SO <sub>2</sub> and NO <sub>2</sub> , both lying within the NAAQS. (Figure 7.3).



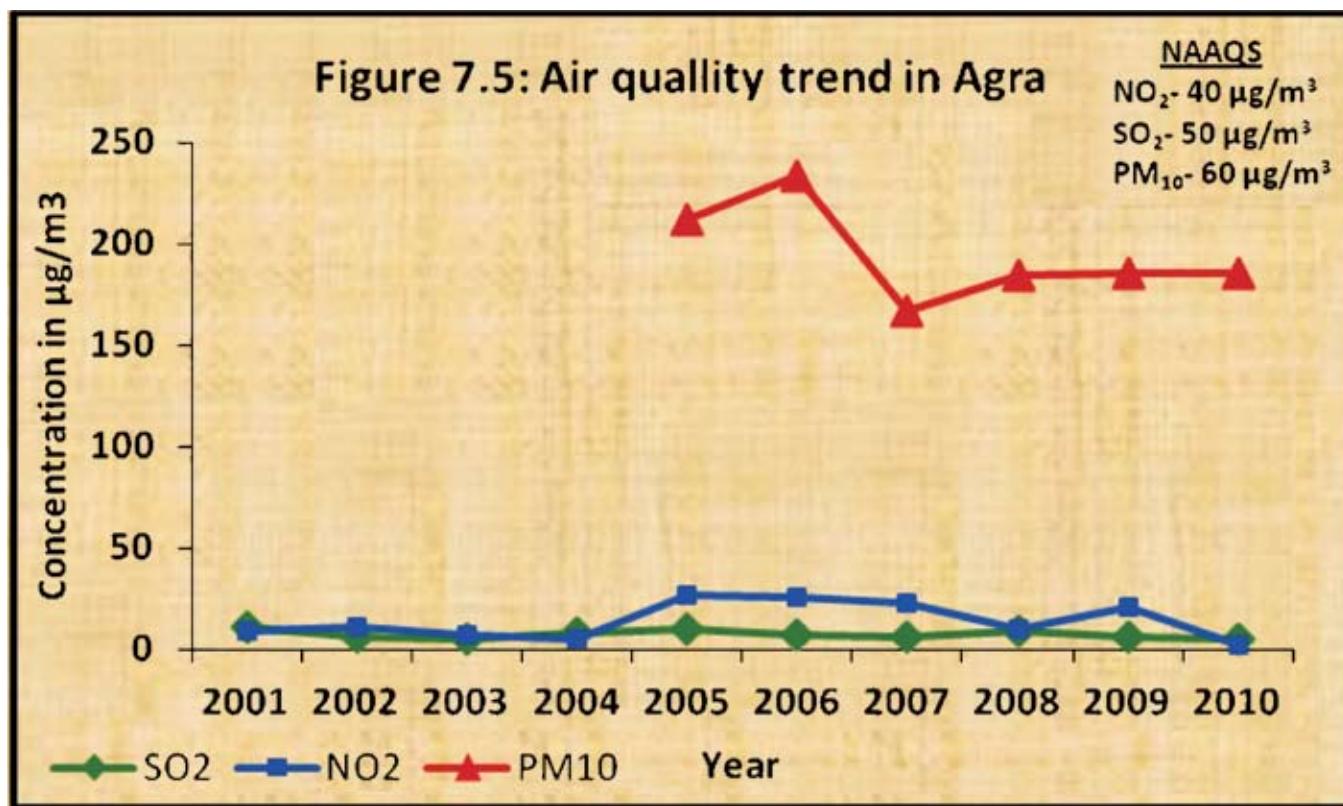
### 7.3.4 LUDHIANA

State	Punjab
Location	Between 30°34' N and 30°01'N and 75°18'E and 76°20'E. Average elevation of 244 metres (798 ft).
Area	310 km <sup>2</sup>
Population	13.93 lacs
Climate	Semi humid in the North and North East to semi arid to arid in the South. Summer, winter and rainy season. Rainfall: average normal rainfall is 670 mm approx. and the annual average rainfall is 437 mm.
Geography	Soil is of yellow sandstone and granite, forming small hillocks, plateaus and dips The city stands on the Sutlej River's old bank, 13 km south of its present course
Industries	Knitwear factories, hosiery yarn mills, bicycles factories, factories for machine tools, sewing machines, generators, diesel engines, tyres & tubes, and other consumer goods
Air quality stations	4 (2 residential, 2 industrial)
Air quality trend	Analysis of nine year air quality data shows fluctuating trend for PM <sub>10</sub> , a decreasing trend for SO <sub>2</sub> and a stable trend for NO <sub>2</sub> (Figure 7.4).



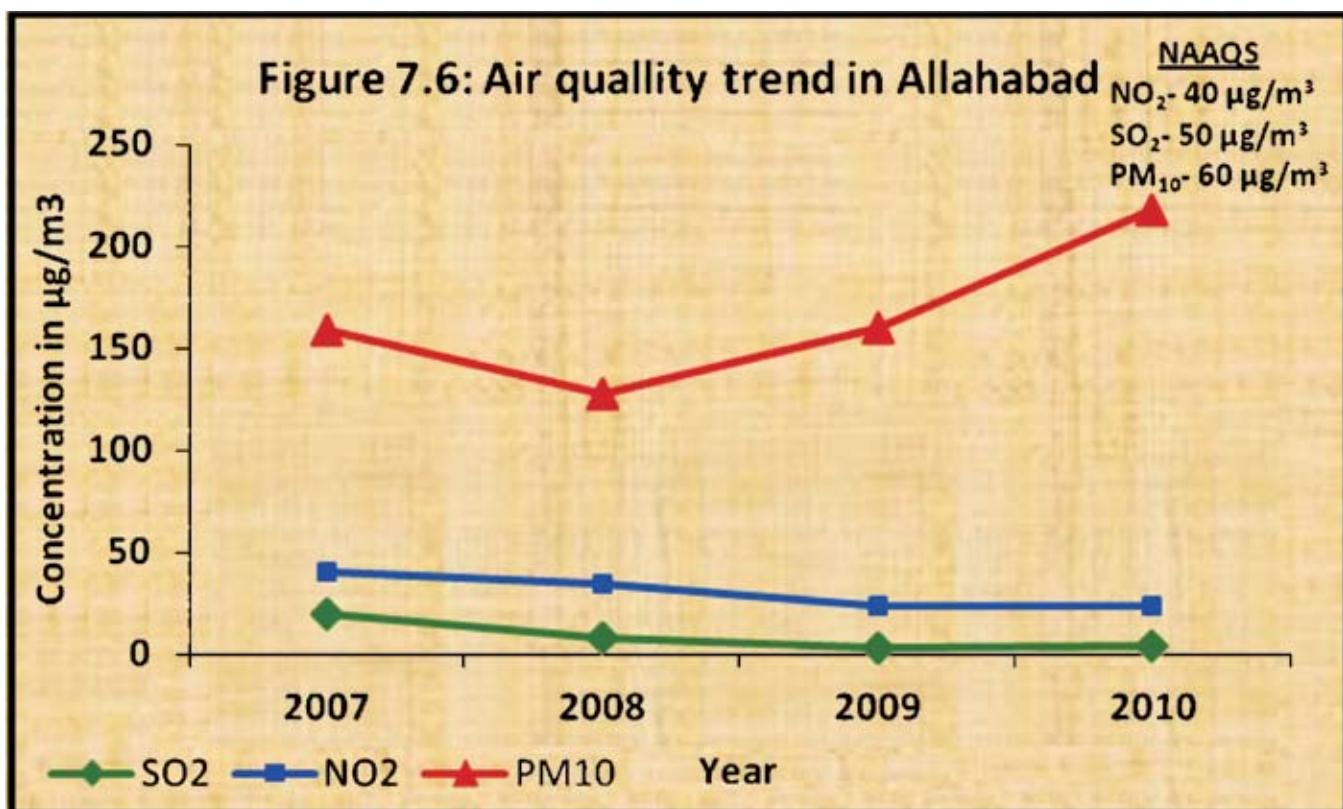
### 7.3.5 AGRA

State	Uttar Pradesh
Location	27°8' to 27°14' N and 77°57' to 78°04' E
Area	140 km <sup>2</sup>
Population	13, 21,410
Climate	Semiarid climate that borders on a humid subtropical climate. Mild winters, hot and dry summers and a monsoon season Temperature: extreme temperature Rainfall: The average rainfall in the region is 685 mm
Geography	Bounded by Thar Desert on its southwest, west and northwest peripheries. Drained by Yamuna river.
Industries	73 industries and 2 industrial clusters. Textiles, hosiery items, woolen, jute, footwear, leather, metal processing, machinery parts, marble, food processing and handicrafts 6,463 small-scale units of various handicraft items like Zari work, leather craft, and marble craft and carpet craft.
Air quality stations	6 (1 residential, 1 industrial, 4 sensitive)
Air quality trend	Analysis of five year air quality data for PM <sub>10</sub> shows a decreasing trend and nine year trend for SO <sub>2</sub> shows a stable trend. As for NO <sub>2</sub> for the trend slightly increased during 2005, 2006 and 2007 but again declined in the later years (Figure 7.5)



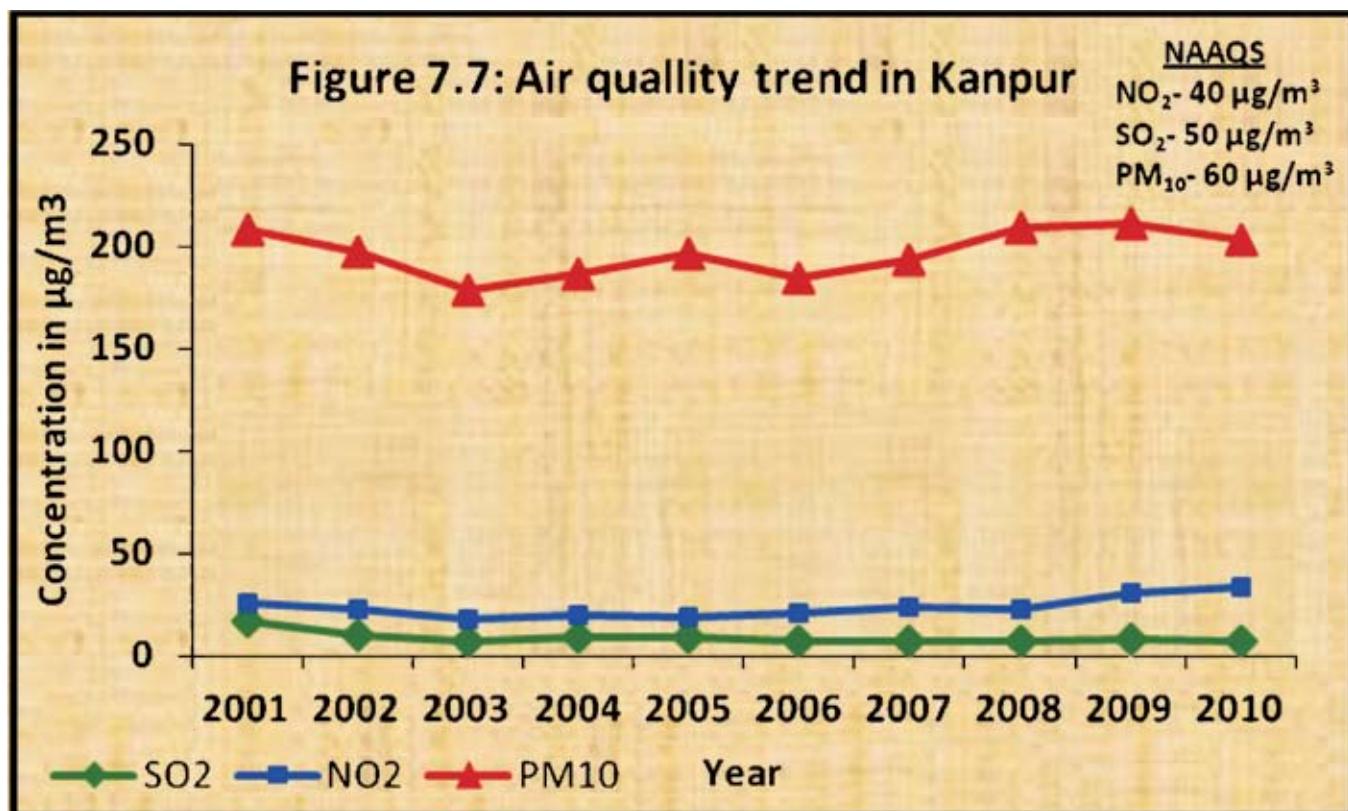
### 7.3.6 ALLAHABAD

State	Uttar Pradesh
Location	Between $24^{\circ} 47'$ and $25^{\circ} 47'$ N and $81^{\circ} 19'$ and $82^{\circ} 29'$ E. Elevation of 98 metres (322 ft)
Area	Length from east to west is 117 km and breadth from north to south is 101 km. Area 7261 sq. kms.
Population	15 lacs
Climate	Humid subtropical climate with hot dry summer, cool dry winter and warm humid monsoon. Monsoon begins in early July and lasts till September. Temperature: ranging between $22^{\circ}\text{C}$ ( $72^{\circ}\text{F}$ ) and $10^{\circ}\text{C}$ ( $50^{\circ}\text{F}$ ). Severe fog in January Rainfall: average rainfall of the city is varies from min 520.6 mm to the highest of 1276.5 mm
Geography	Soil fertile but not too moist. The southern and eastern parts are dry and rocky. Stands at the confluence of two rivers the Ganges and Yamuna
Industries	Glass and wire based industries, fertilizer complex based on naphtha as feed stock, three mega thermal power projects
Air quality stations	2 (2 residential)
Air quality trend	Analysis of three year air quality data shows a more or less stable trend for both $\text{SO}_2$ and $\text{NO}_2$ , both lying within the NAAQS (Figure 7.6).



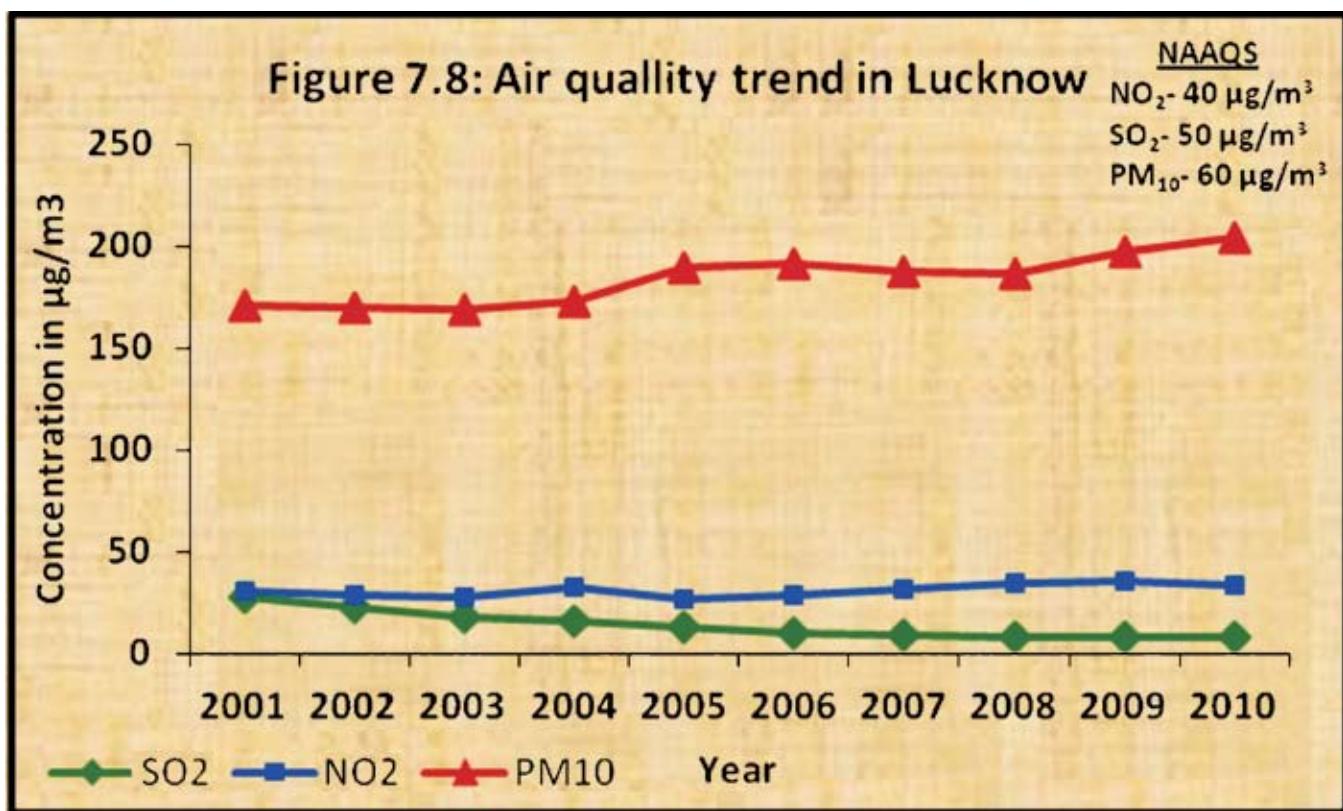
### 7.3.7 KANPUR

State	Uttar Pradesh
Location	26°28'N and 80°21'E
Area	278 km <sup>2</sup>
Population	26,90,486
Climate	<p>Humid subtropical climate with very hot summers, mild and relatively short winters, dust storms and a monsoon season. Severe fog in December and January. Summer excessive dry heat is accompanied by dust storms and loo. Rains appear between July and September almost at the end of regular monsoon season.</p> <p>Temperature: mean maximum monthly temperatures 41.7°C during May and minimum 22.8°C in January</p> <p>Rainfall: average normal annual rainfall is 833.5 mm</p>
Geography	The area is underlain by Indo-Gangetic alluvium of quaternary age formed by fluvial processes comprising of clay, silts, sands of various texture and kankar in varying proportion Surrounded by two main rivers of India, the Ganges in the northeast and the Pandu River (Yamuna) in the south.
Industries	Biggest producers of textile and leather products. Fertilizer, chemicals, two wheelers, soaps, pan masala, hosiery and engineering industries are also present. The total number of small scale industries registered is 12000
Air quality stations	7 (4 residential, 3 industrial)
Air quality trend	Analysis of nine year air quality data shows a more or less stable trend for both SO <sub>2</sub> and NO <sub>2</sub> , both lying within the NAAQS. For PM <sub>10</sub> , however, a fluctuating trend is seen which exceeds the NAAQS (Figure 7.7).



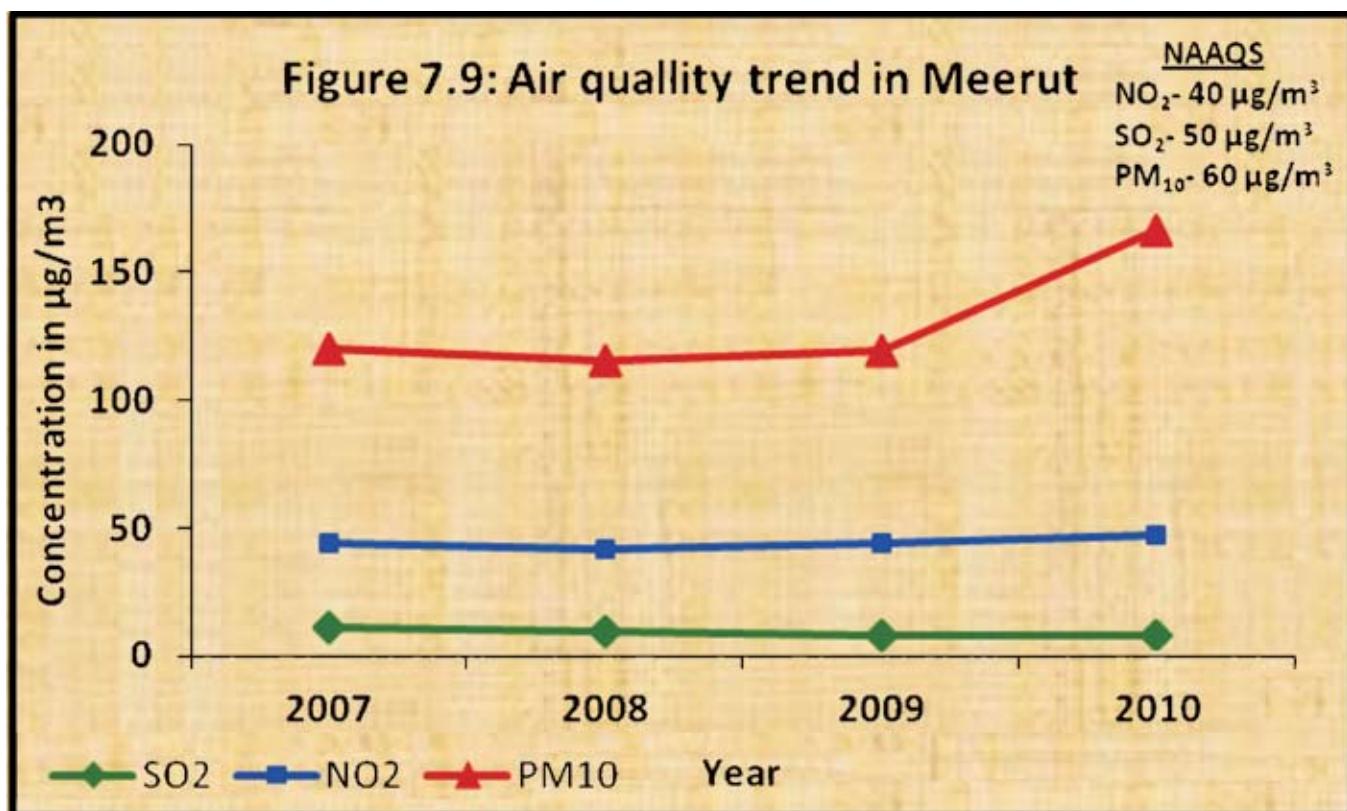
### 7.3.8 LUCKNOW

State	Uttar Pradesh
Location	26° 30' and 27° 10' N and 80° 34' and 81° 12' E
Area	2528 sq.kms
Population	25 lacs
Climate	Humid subtropical climate with cool, dry winters from December to February and dry, hot summers from April to June. The rainy season is from mid-June to mid-September. Fog is quite common from late December to late January. Dry except during Southwest monsoon period Temperature: In winter the maximum temperature is around 25 °C and the minimum is in the 6 to 8 °C. Summers are very hot with temperatures rising to the 40 to 45 °C Rainfall: average normal rainfall of the city is approximately 1100 mm
Geography	Situated in gangetic plain and drained by Gomti river. Located in the seismic zone
Industries	Pharmaceutical industries, sugarcane plantations and sugar industries ,small scale industries that are based on unique styles of embroidery, producer of tobacco products and handicrafts such as pottery, earthen toys, silver and gold foil work, and bone carving products.
Air quality stations	5 (4 residential, 1 industrial)
Air quality trend	Analysis of nine year air quality data shows a more or less stable trend for SO <sub>2</sub> and a declining trend for NO <sub>2</sub> , both lying within the NAAQS. For PM <sub>10</sub> , however, an increasing trend is seen which exceeds the NAAQS (Figure 7.8).



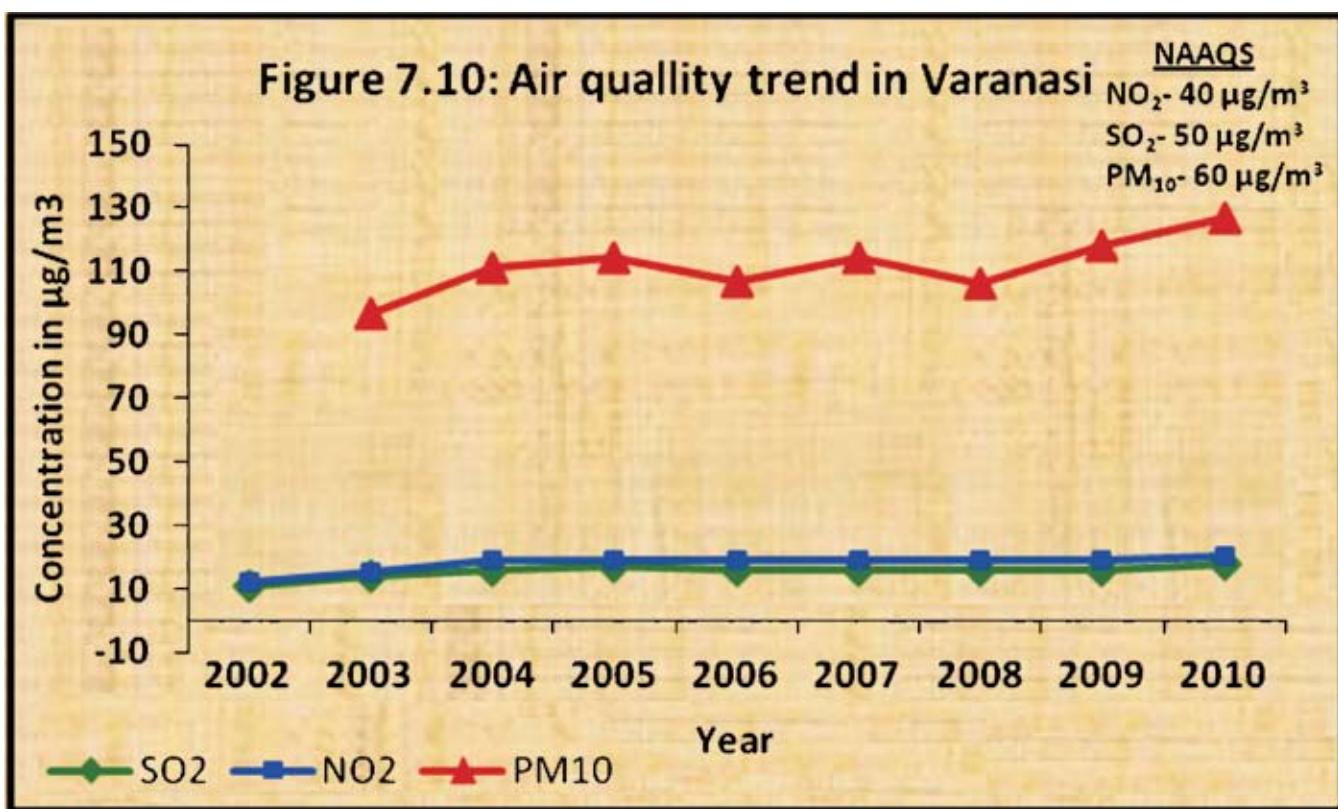
### 7.3.9 MEERUT

State	Uttar Pradesh
Location	28°57' to 29°02' N and 77°40' to 77°45' E
Area	142 km <sup>2</sup>
Population	11,67,399
Climate	Moderate type of climate. Very hot summers and very cold winters. Visibility is almost zero during November to January due to fog. Temperature: summers can reach 48 degree Celsius. Lowest temperature recorded is 0.5 degrees. Rainfall: average annual rainfall is about 1000 mm
Geography	The ground is not rocky and there are no mountains. Meerut lies between plains of rivers Ganges and Yamuna
Industries	14,000 registered industrial units in the metropolitan city of Meerut, out of which only about 9,000 units are functional at present. Distillery and small scale industries like sports goods, chemicals, food processing, surgical goods, engineering works, petrochemicals, rubber, plastic, leather goods, flour mills and readymade garments predominate in the area
Air quality stations	2 (2 residential)
Air quality trend	Analysis of three year air quality data shows a more or less stable trend for all the pollutants. PM <sub>10</sub> , however, exceeds the NAAQS (Figure 7.9).



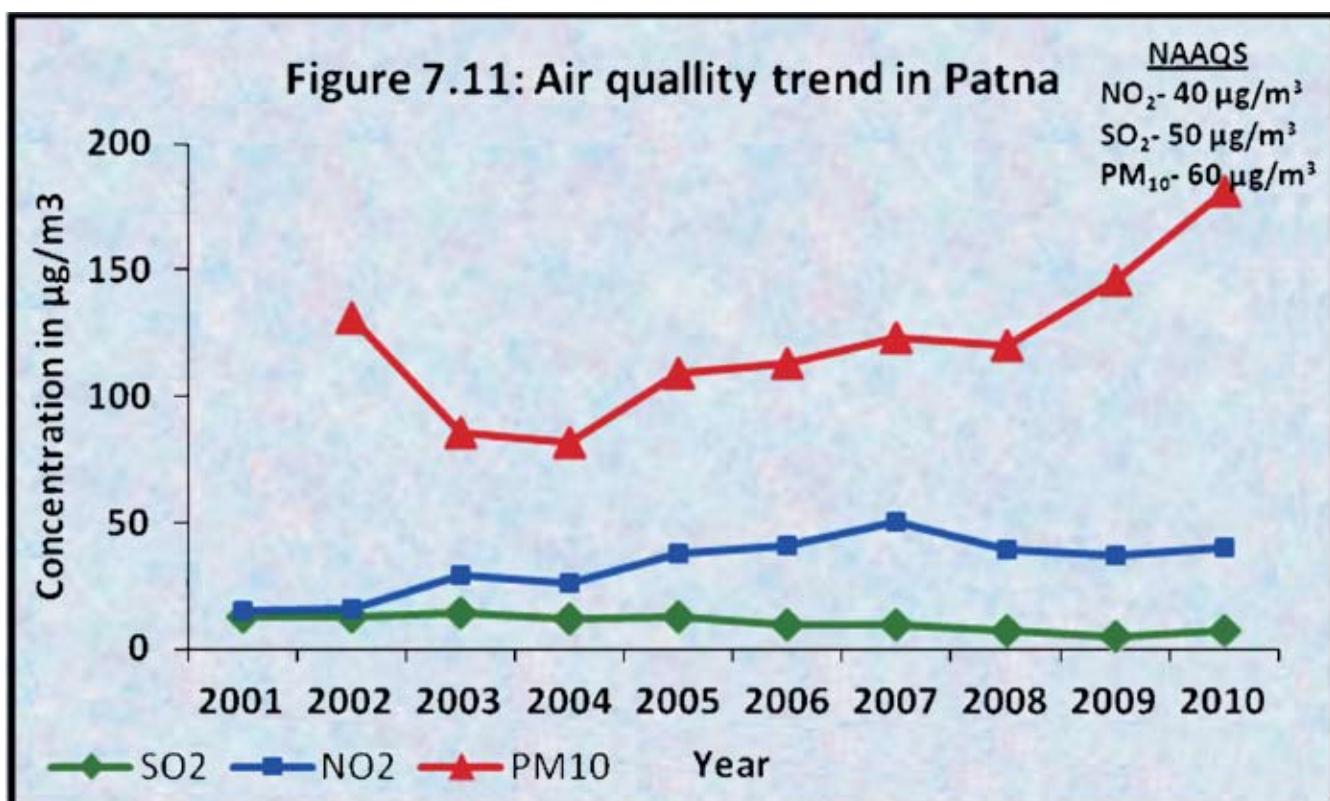
### 7.3.10 VARANASI

State	Uttar Pradesh
Location	Between 82° 15' to 83° 30' E and 24° 35' to 25° 30' N
Area	112.26 km <sup>2</sup> (approximately 43 mi <sup>2</sup> ). Mean elevation is 80.71m
Population	14 lacs
Climate	<p>Humid subtropical climate with large variations between summer and winter temperatures. Summers are long, from early April to October, with intervening monsoon seasons and are also extremely hot. Winters in Varanasi sees very large diurnal variations, with warm days and downright cold nights. Cold waves from the Himalayan region</p> <p>Temperature: The temperature ranges between 32°C – 46 °C (90°F – 115 °F) in the summers and below 5 °C during December to February</p> <p>Rainfall: average normal rainfall of the city is varied from min 3.3 mm to the highest of 113.4 mm</p>
Geography	Divided into two physical regions, the northern alluvial plain and the southern plateau area. The northern alluvial plain is drained by the Ganga and its tributaries namely the Gomti and the Varuna rivers and Assi .
Industries	Diesel locomotive factory, oxygen plant, small cottage industries include silk making making, the production of textiles such as hand-woven carpets, and handicrafts
Air quality stations	2 (2 residential)
Air quality trend	Analysis of three year air quality data shows a more or less stable trend for SO <sub>2</sub> and. PM <sub>10</sub> however, shows an increasing trend and exceeds the NAAQS (Figure 7.10).



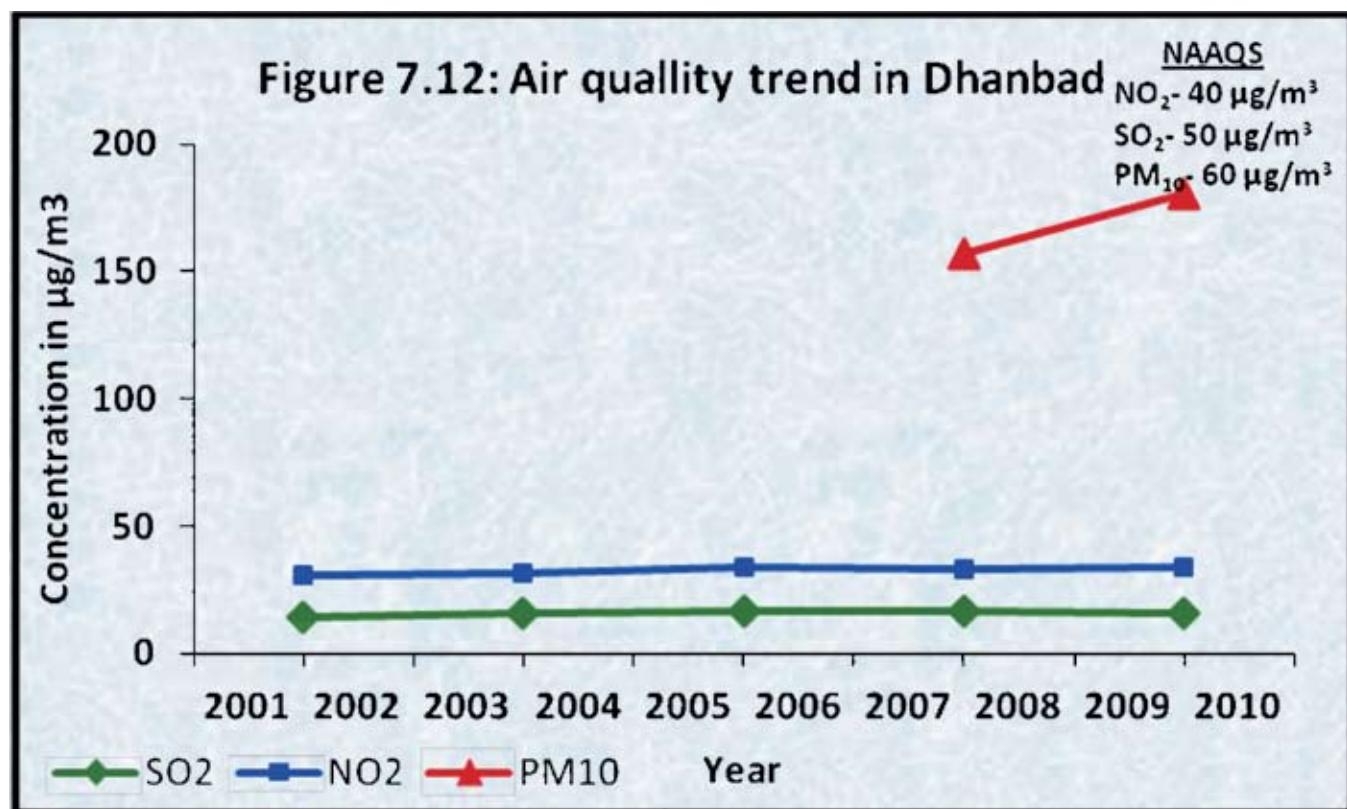
### 7.3.11 PATNA

State	Bihar
Location	25°22'12" N and 85°7'48" E
Area	125 km <sup>2</sup>
Population	17,07,429
Climate	Tropical type characterized by three distinct seasons Temperature: maximum temperature is 31.6 °C varying between 23.6°C in January to 38.9°C in the month of May while the night temperature varies between 11 to 27.1°C with mean annual value of 20.8 °C Rainfall: relative humidity is comparatively higher over the year ranging between 41 to 83% lowest being in the month of April. The bulk of the annual rainfall (1109.8mm) is received through South Western monsoon between the period June to September.
Geography	River Punpun flows south of township limit and Ganga River is it's Northern limit. The township and surrounding is underlain by thick fluvial sediments deposited by the river Ganga and its right bank tributaries, Sone and Punpun. Basically the deposits belong to Quaternary period and are flood plain deposits. The sediments are admixture of clay and sand of different grades.
Industries	Plastic and steel
Air quality stations	2 (2 residential)
Air quality trend	Analysis of three year air quality data shows a more or less stable trend for SO <sub>2</sub> and. PM <sub>10</sub> however, shows an increasing trend and exceeds the NAAQS (Figure 7.11).



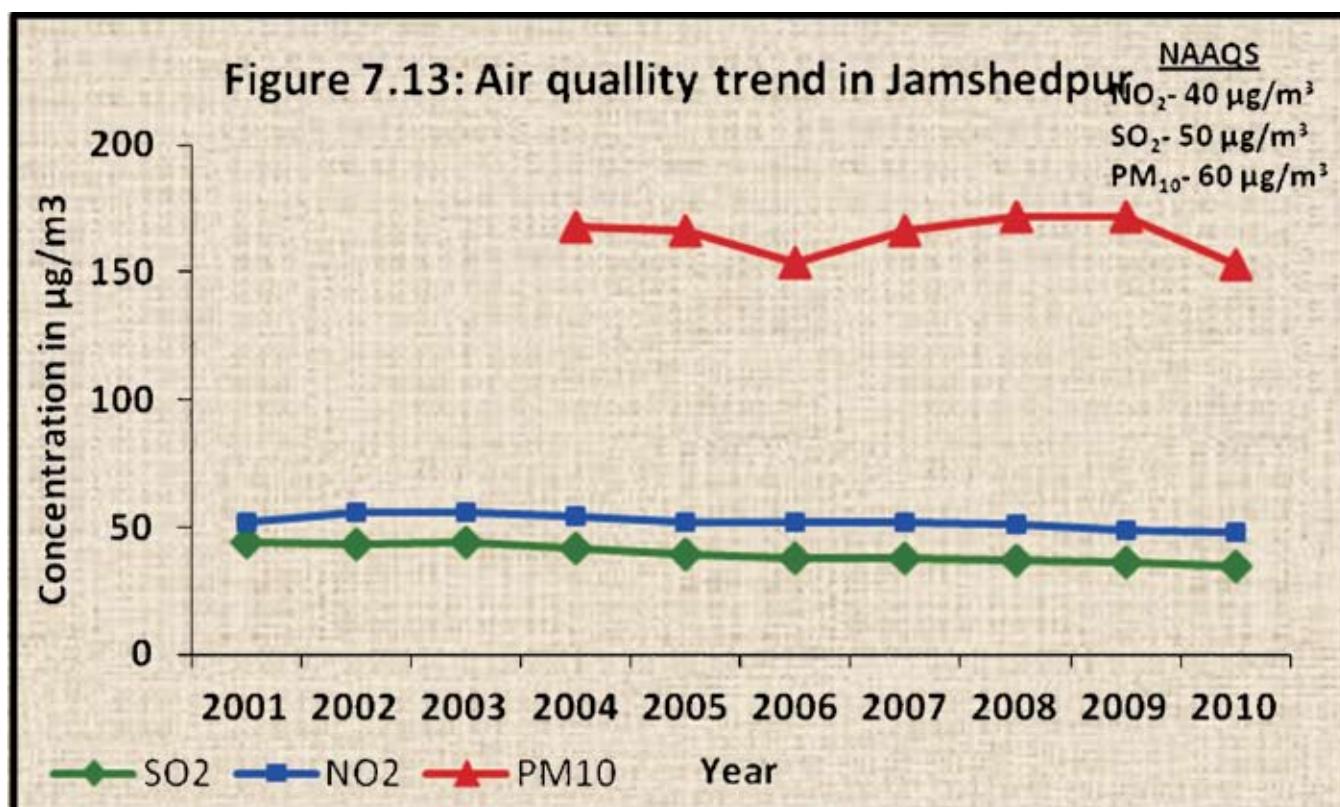
### 7.3.12 DHANBAD

State	Jharkhand
Location	23°48' N and 86°27' E
Area	355.77 km <sup>2</sup>
Population	10,64,357
Climate	<p>Dry and hot summer and a dry and cold winter with an intermediate monsoon period from the middle of June to the end of September. The summer is extremely hot, whereas the winter from November to February is very pleasant</p> <p>Temperature: varies from 8°C to 34°C. After February, the climate becomes warmer till the rains break in the middle of June. The temperature during these four months from March to June usually varies from 13°C to 45.5°C. July to October, which include the rainy season, temperature usually ranges from 15°C to 36°C.</p> <p>Rainfall: Average rainfall of the area is 1310.6 mm</p>
Geography	Crystalline metamorphites of Archaean (Dharwar) age which form the basement. Over these rocks were deposited in slowly sinking faulted troughs (basins), the Lower Gondwana group of sedimentary strata including the coal-bearing beds
Industries	Coal and coal based industries. The total number of small scale industries registered is about 300, out of which 150 are coal based and 150 of other types.
Air quality stations	1 (1 residential)
Air quality trend	Analysis of three year air quality data shows a more or less stable trend for SO <sub>2</sub> and. PM <sub>10</sub> , however, shows an increasing trend and exceeds the NAAQS (Figure 7.12).



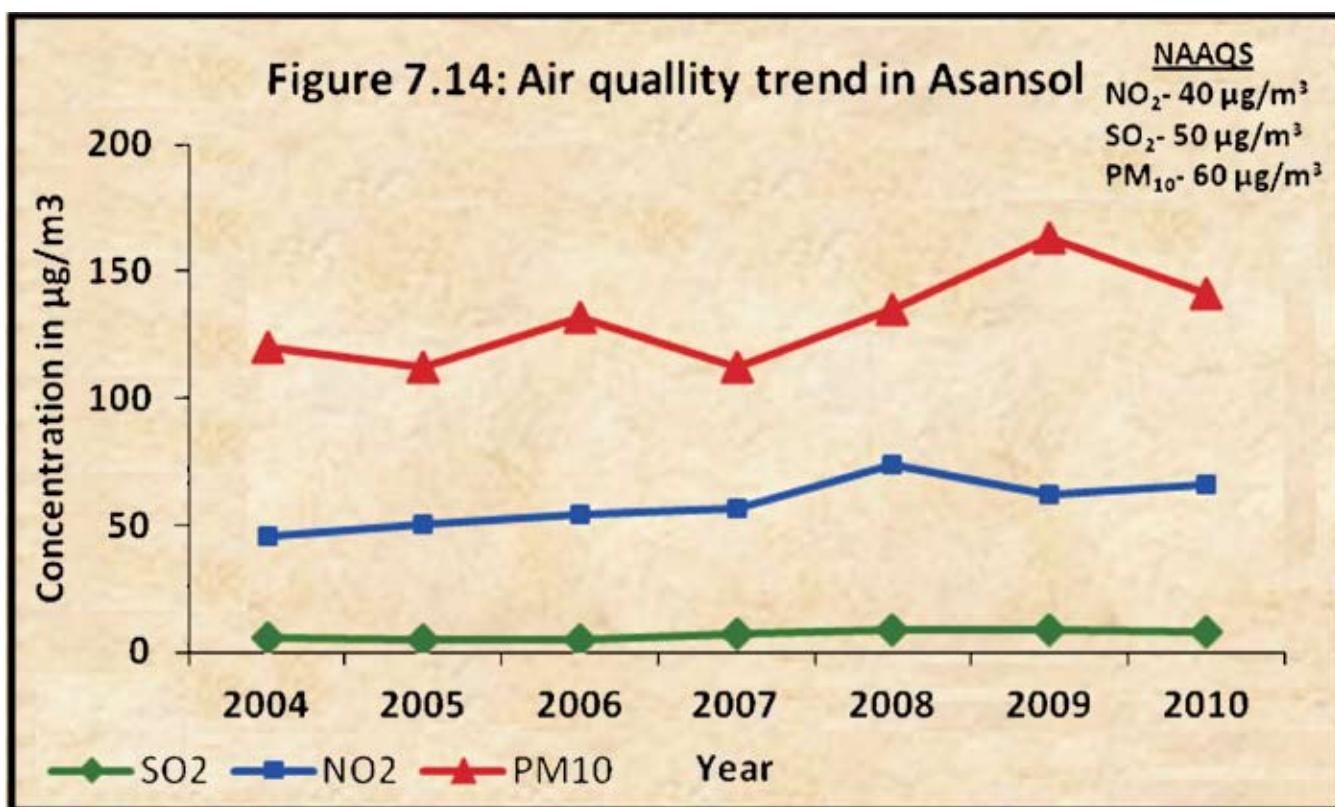
### 7.3.13 JAMSHEDPUR

State	Jharkhand
Location	22°48' N and 86°11' E
Area	149.23 km <sup>2</sup>
Population	11,01,804
Climate	<p>Humid climate due to inland position and presence of hills</p> <p>Temperature: day temperature is quite high in summer, generally around 43°C occasionally reaching up to 48°C</p> <p>Rainfall: annual rainfall in Singhbhum district is recorded as 1434 mm.</p>
Geography	Diverse rock types are developed with a none-too-simple structure of Dunn. The areas surrounding Jamshedpur are rich in minerals, including <u>iron ore</u> , <u>coal</u> , <u>manganese</u> and <u>lime</u> .
Industries	The main industries include <u>iron</u> and <u>steel</u> , truck manufacturing, tinplate production, cement, plastic and rubber, chemicals, food and beverage, pharmaceutical, electrical, sponge foam, LPG bottling plant and other small and medium scale industries.
Air quality stations	2 (2 industrial)
Air quality trend	Analysis of six year air quality data of PM10 shows a slight increase and is above NAQS. SO <sub>2</sub> and PM <sub>10</sub> however, shows a stable trend (Figure 7.13).



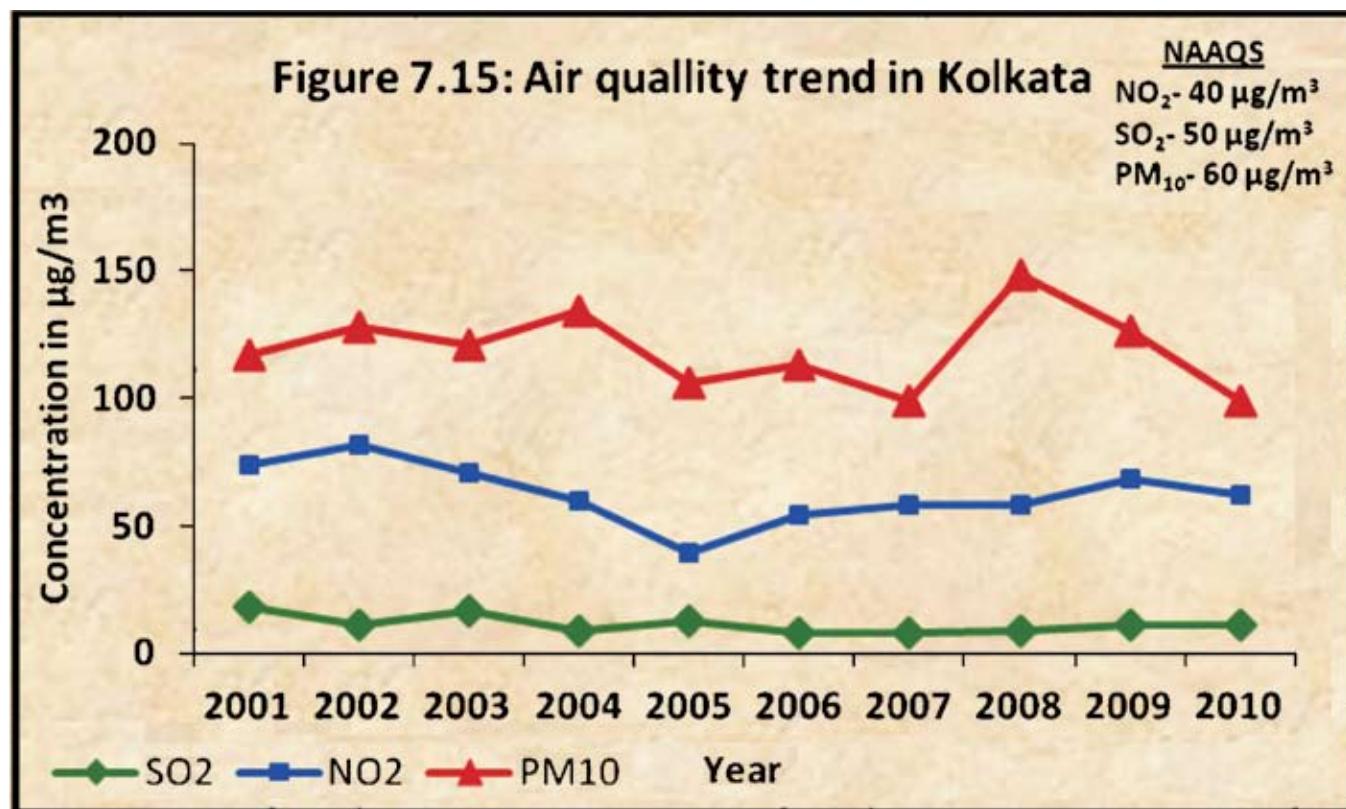
### 7.3.14 ASANSOL

State	West Bengal
Location	23°41' N and 86°59' N E
Area	127.237 km <sup>2</sup>
Population	10,64,357
Climate	Dry and hot in summer and dry and cold in winter with an intermediate monsoon period from the middle of June to the end of September  Temperature: Maximum temperature 35 °C during summer and minimum of 4 °C during winter  Rainfall: Maximum of 533 mm during July
Geography	Lies on Gondwana rocks between rivers Damodar and Ajay. A small rivulet, Nunia, flows past Asansol
Industries	Coal mines, iron and steel, polymer industries, cement, plastic, mustard oil, rubber, leather products, polymer pipes, fabrication, paint and varnish, flour mills, PVC pipes, aromatic chemicals, food product packing etc. The total number of small scale industries registered is about 500
Air quality stations	3 (2 residential, 1 industrial)
Air quality trend	Analysis of six year air quality data of PM10 shows fluctuating trend and is above NAAQS. SO <sub>2</sub> and NO <sub>x</sub> shows a stable trend. (Figure 7.14).



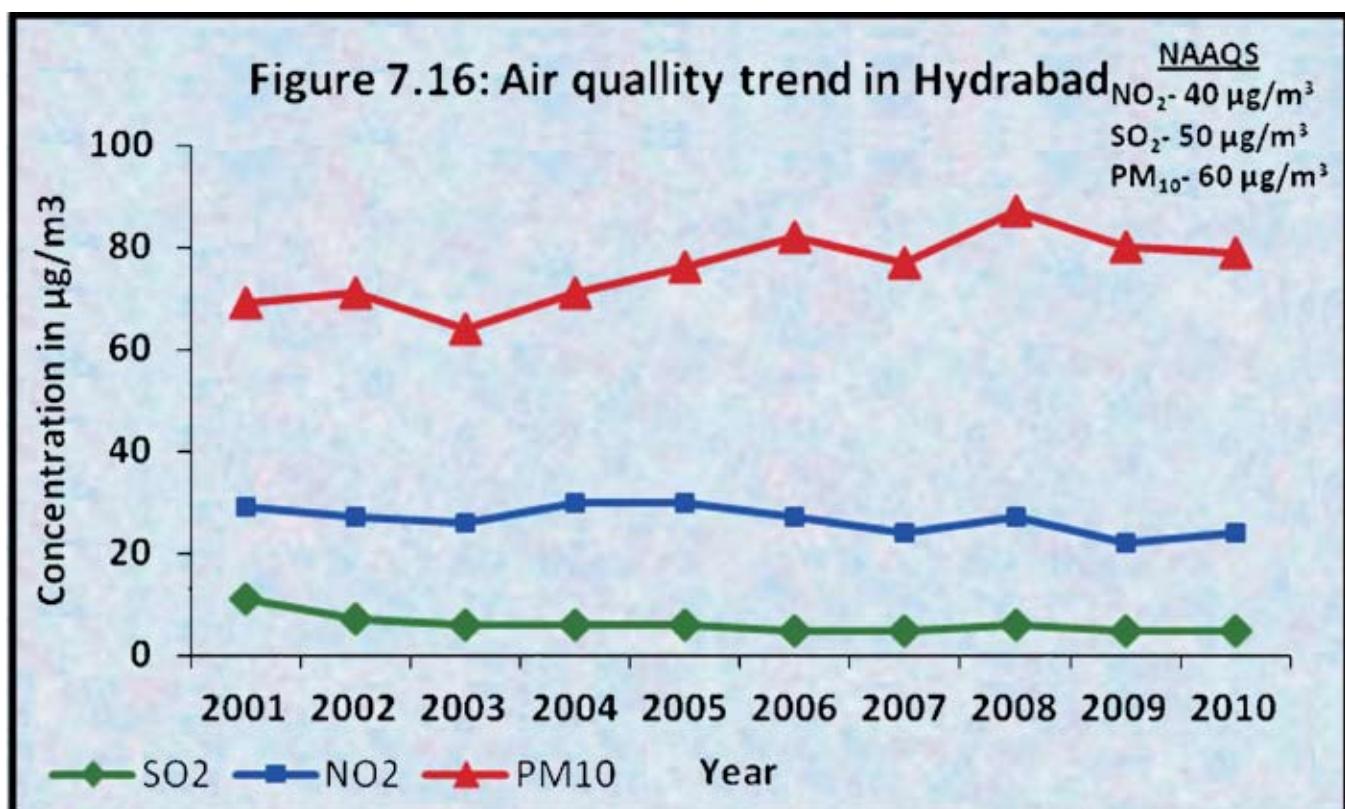
### 7.3.15 KOLKATA

State	West Bengal
Location	22°33' N and 88°20' E
Area	1750 km <sup>2</sup> . elevation ranging between 1.5 m (5 ft) to 9 m (30 ft) <sup>l</sup>
Population	1,32,16,546
Climate	<p>Tropical wet-and-dry climate. Summers are hot and humid with temperatures in the low 30's and during dry spells the maximum temperatures often exceed 40 °C (104 °F) during May and June. Winter tends to last for only about two and a half months, with seasonal lows dipping to 9 °C – 11 °C (54 °F – 57 °F) between December and January. Dusty squalls followed by thunderstorm or hailstorms and heavy rains with ice sleets lash during early summer. <u>Southeast monsoon</u> rains lash the city between June and September</p> <p>Temperature: annual mean temperature is 26.8 °C; monthly mean temperatures range from 19°C to 30°C</p> <p>Rainfall: annual rainfall of 1,582 mm</p>
Geography	Spread linearly along the banks of the River Hooghly in a north-south direction. Soil type is alluvial. Quaternary sediments consisting of clay, silt, various grades of sand and gravel. These sediments are sandwiched between two clay beds, the lower one at depths between 250 m (820 ft) and 650 m (2,133 ft) and the upper one ranging between 10 m (33 ft) and 40 m (131 ft) in thickness. The town falls under seismic zone-III and wind and cyclone zone
Industries	Electronics to jute.
Air quality stations	10 (7 residential, 3 industrial)
Air quality trend	Analysis of nine year air quality data of PM <sub>10</sub> shows a fluctuating trend. However, 2009 shows a reduction in the pollutant. NO <sub>2</sub> shows a slightly increasing trend. Both PM <sub>10</sub> and NO <sub>2</sub> exceeds the NAAQS. SO <sub>2</sub> seems stable and well within limits. (Figure 7.15).



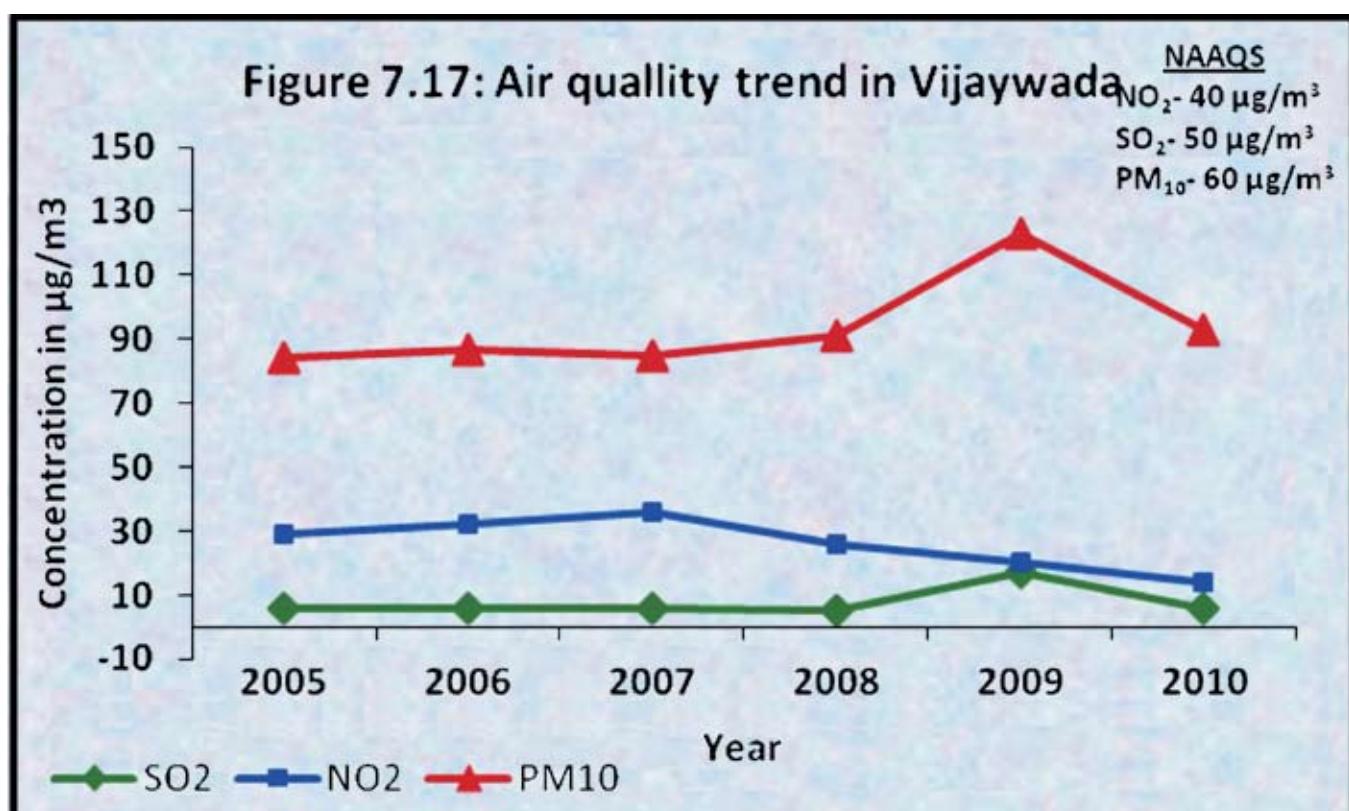
### 7.3.16 HYDRABAD

State	Andhra Pradesh
Location	17°12' N and 78°18' E. Average elevation of about 536 metres above sea level (1,607 ft)
Area	1000 km <sup>2</sup>
Population	55,33,640
Climate	Combination of a tropical wet and dry climate that borders on a hot semi-arid climate with hot summers from late February to early June, the monsoon season from late June to early October and a pleasant winter from late October to early February.. Temperature: Moderate annual range of temperature  Rainfall: The normal rainfall of the area is 805 mm with 76% from South-West monsoon
Geography	Situated on the Deccan Plateau. Most of the area has a rocky terrain and some areas are hilly. Spreads on the North and South bank of the river Musi, a tributary of Krishna. The Hussain Sagar Lake is centrally located in the city and connecting the Hyderabad and Secunderabad twin cities Geomorphologically the area is divided into (1) Residual Hills (2) Pediment inselberg complex (3) Shallow to moderate weathered pediplains and (4) Valley hills.
Industries	Cotton, cigarettes, refrigerators, machine tools, oil, drugs, pharmaceuticals, printing material, mint
Air quality stations	9 (5 residential, 3 industrial, 1 sensitive)
Air quality trend	Analysis of nine year air quality data of PM <sub>10</sub> shows a fluctuating trend. However, 2009 shows a reduction in the pollutant. NO <sub>2</sub> shows a slightly increasing trend. Both PM <sub>10</sub> and NO <sub>2</sub> exceeds the NAAQS. SO <sub>2</sub> seems stable and well within limits. (Figure 7.16).



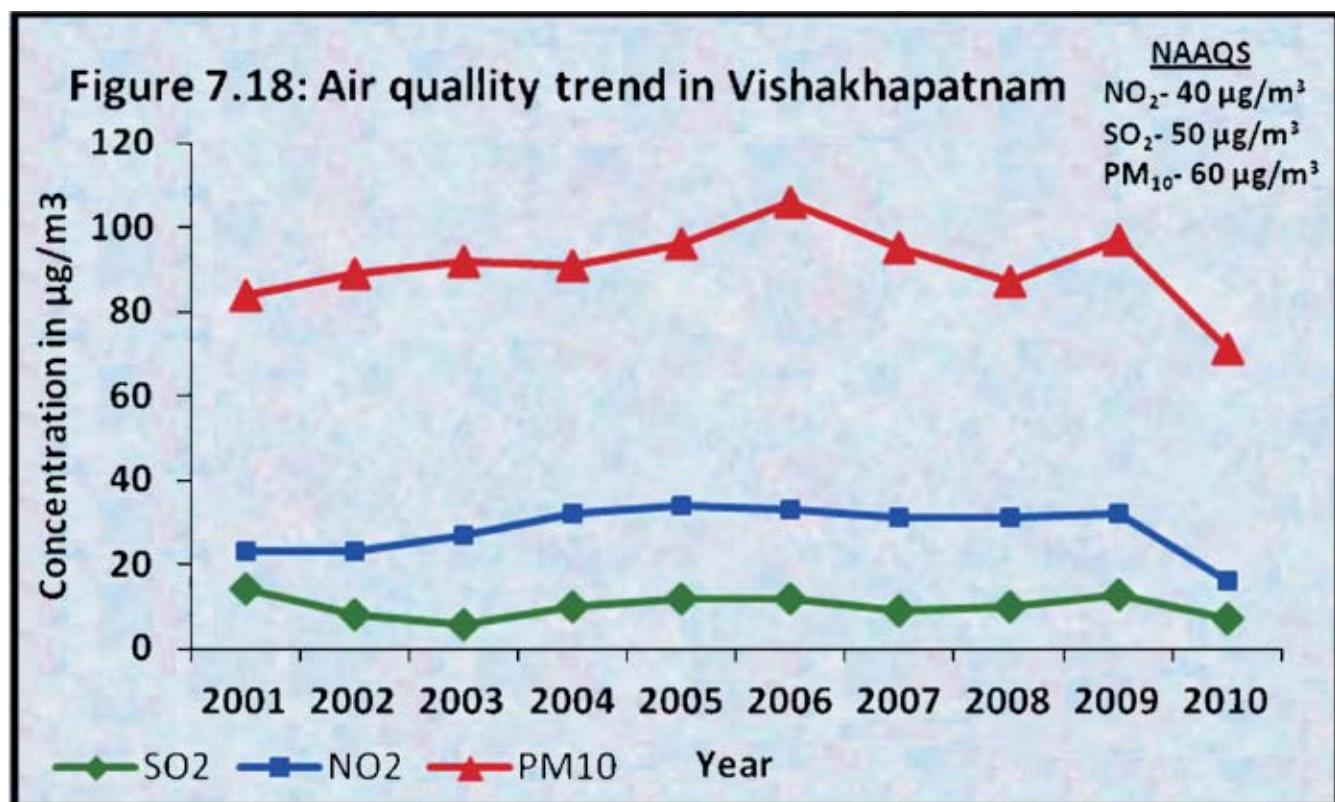
### 7.3.17 VIJAYWADA

State	Andhra Pradesh
Location	16°31' N and 80°39' E
Area	73 km <sup>2</sup>
Population	10,11,152.
Climate	Tropical, specifically a tropical wet and dry climate, with hot summers and moderate winters. Temperature: peak temperature reaches 47 °C (117 °F) in May-June, while the winter temperature is 20-27 °C Rainfall: normal rainfall of the district is 1028 mm
Geography	located on the banks of the Krishna River and bounded by the Indrakiladri Hills on the West and the Budameru River on the North. Soil is very fertile and cultivated intensively.
Industries	Rice mills, edible oil, beverages, tobacco products, cotton textiles, wood and wood products, paper and paper products, leather, rubber, plastic products, motor vehicle spare parts, utensils, scientific instruments, dall and flour mills, chemicals, pharmaceuticals, oil refinery of used motor oils, brawn oil companies, ayurvedic medicines, pickle companies
Air quality stations	2 (1 residential, 1 industrial)
Air quality trend	Analysis of five year air quality data of PM <sub>10</sub> and SO <sub>2</sub> shows a fluctuating trend, NO <sub>2</sub> shows a decreasing trend. However NO <sub>x</sub> and SO <sub>2</sub> are within NAAQS (Figure 7.17).



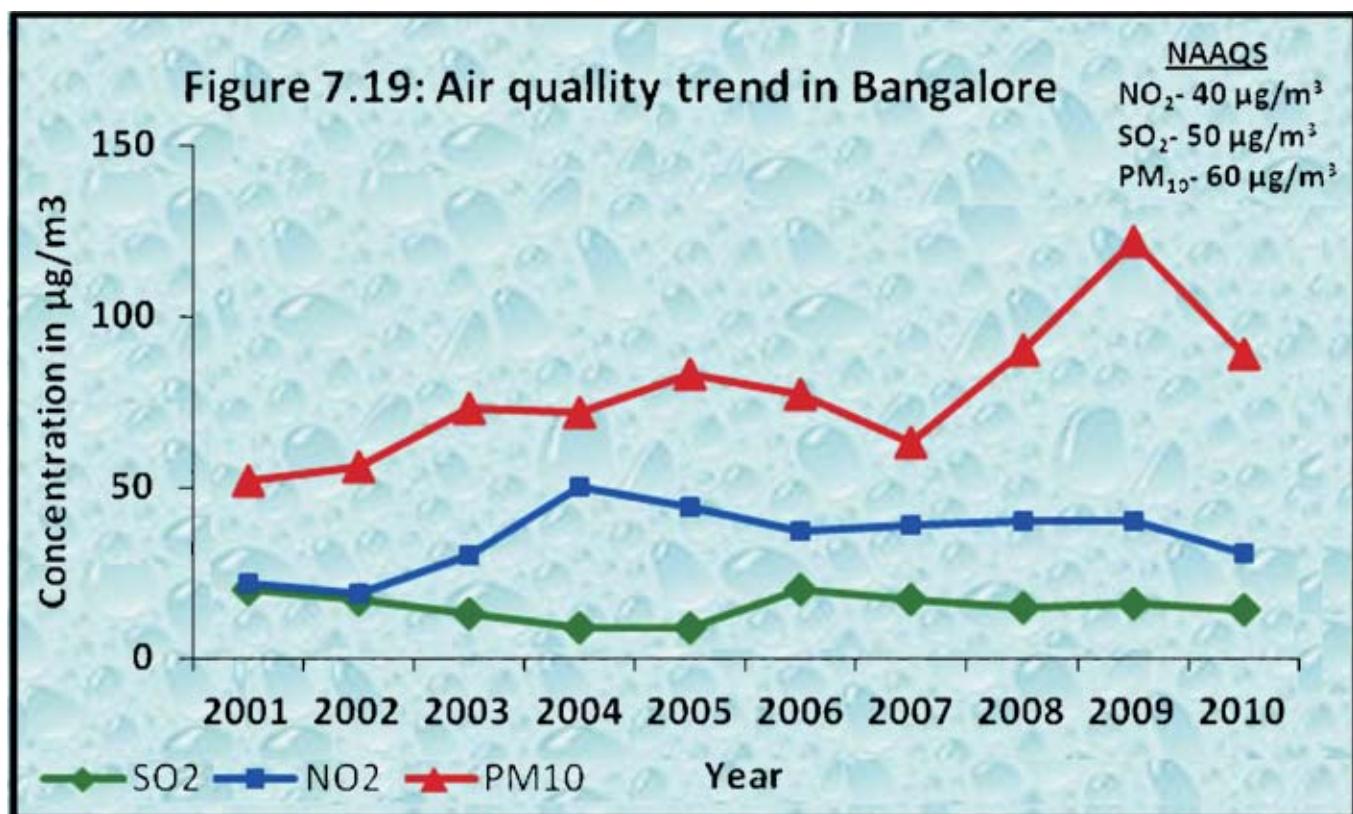
### 7.3.18 VISHAKHAPATNAM

State	Andhra Pradesh
Location	17°43' N and 83°17' E
Area	Vishakhapatnam urban area comprises Vishakhapatnam Municipal Corporation covering 111 km <sup>2</sup> and Gajuvaka Municipality with an area of 97 km <sup>2</sup>
Population	13,29,472
Climate	Tropical savanna climate with little variation in temperature through the year. High humidity throughout the year with aggressive summer and pleasant winter Temperature: temperature generally varies from 28 to 38°C in summer and 18 to 30°C in winter mean temperature ranges from 23.5 to 30°C  Rainfall: mean annual rainfall of the area is 982 mm
Geography	Situated among the hills of the Eastern Ghats and faces the Bay of Bengal to the east. Forms a part of Eastern Ghat tectonic complex of Archaean age which include khondalites, charnockite and migmatite groups
Industries	Shipyard, steel, refinery, fertilisers, heavy plates and vessels, dredging
Air quality stations	8 (4 residential, 3 industrial, 1 sensitive)
Air quality trend	Analysis of nine year air quality data of PM <sub>10</sub> shows a fluctuating trend, NO <sub>2</sub> and SO <sub>2</sub> shows a stable trend and are within NAAQS (Figure 7.18).



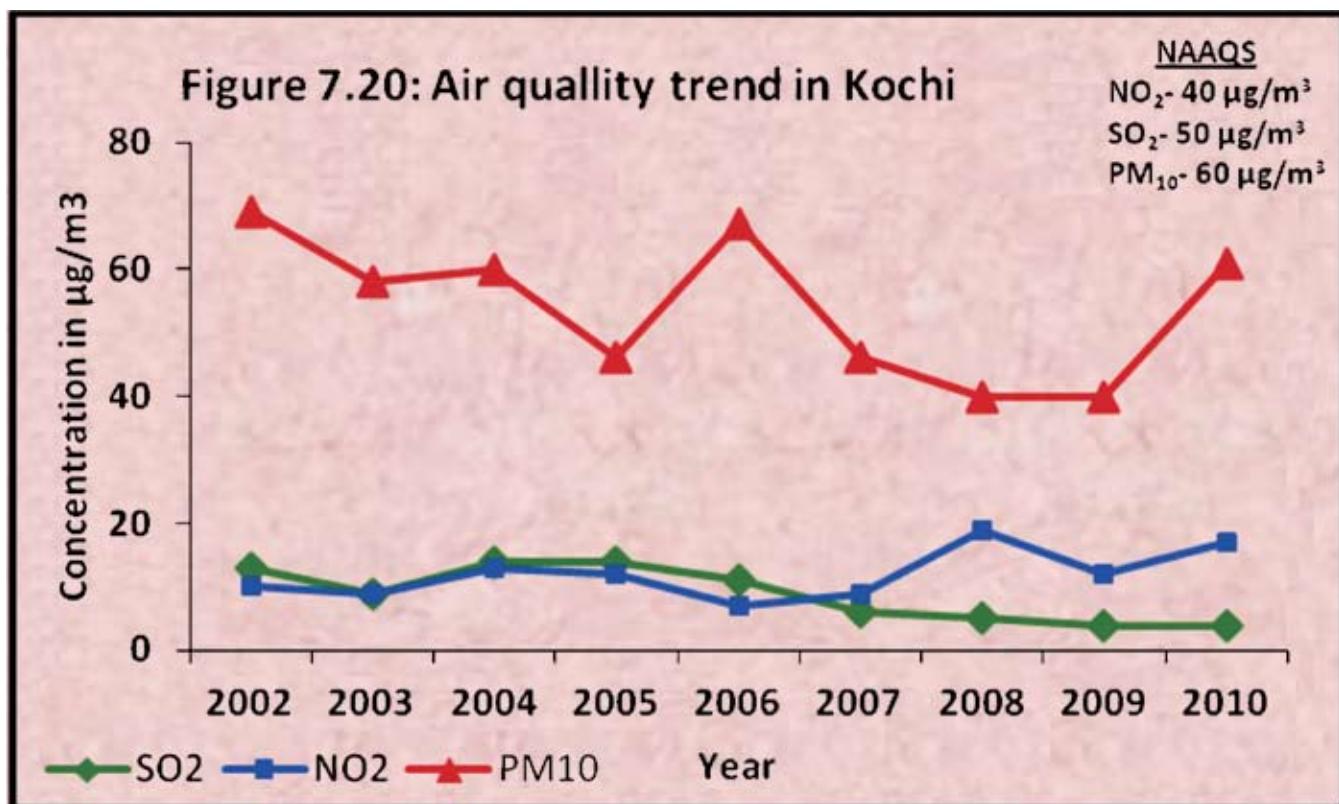
### 6.3.19 BANGALORE

State	Karnataka
Location	12°34'48" N and 77°22'48" E. Altitude of 920 m above MSL
Area	1000 km <sup>2</sup>
Population	56,86,844
Climate	<p>Tropical savanna climate with distinct wet and dry seasons. Due to its high elevation, Bangalore usually enjoys a more moderate climate throughout the year. The summer heat is moderated by fairly frequent thunderstorms.</p> <p>Temperature: 28 to 36°C during hottest months (April/May) to 16 to 25°C during winter months (December/January).</p> <p>Rainfall: average rainfall is 686 mm</p>
Geography	Located on the Deccan Plateau in the south-eastern part of Karnataka. Soils consist of red laterite and red, fine loamy to clayey soils
Industries	Silicon valley of India. Major industries are aircraft, earthmoving equipments, watches, garments, silk, machine tools, handicrafts, computer software, computer hardware, electronics, telecommunication, instrumentation and information technology, steel and coffee.
Air quality stations	9 (5 residential, 4 industrial)
Air quality trend	Analysis of nine year air quality data of PM <sub>10</sub> shows an increasing trend with an abrupt increase after 2007. SO <sub>2</sub> and NO <sub>2</sub> is more or less stable after 2006 and are within NAAQS (Figure 7.19).



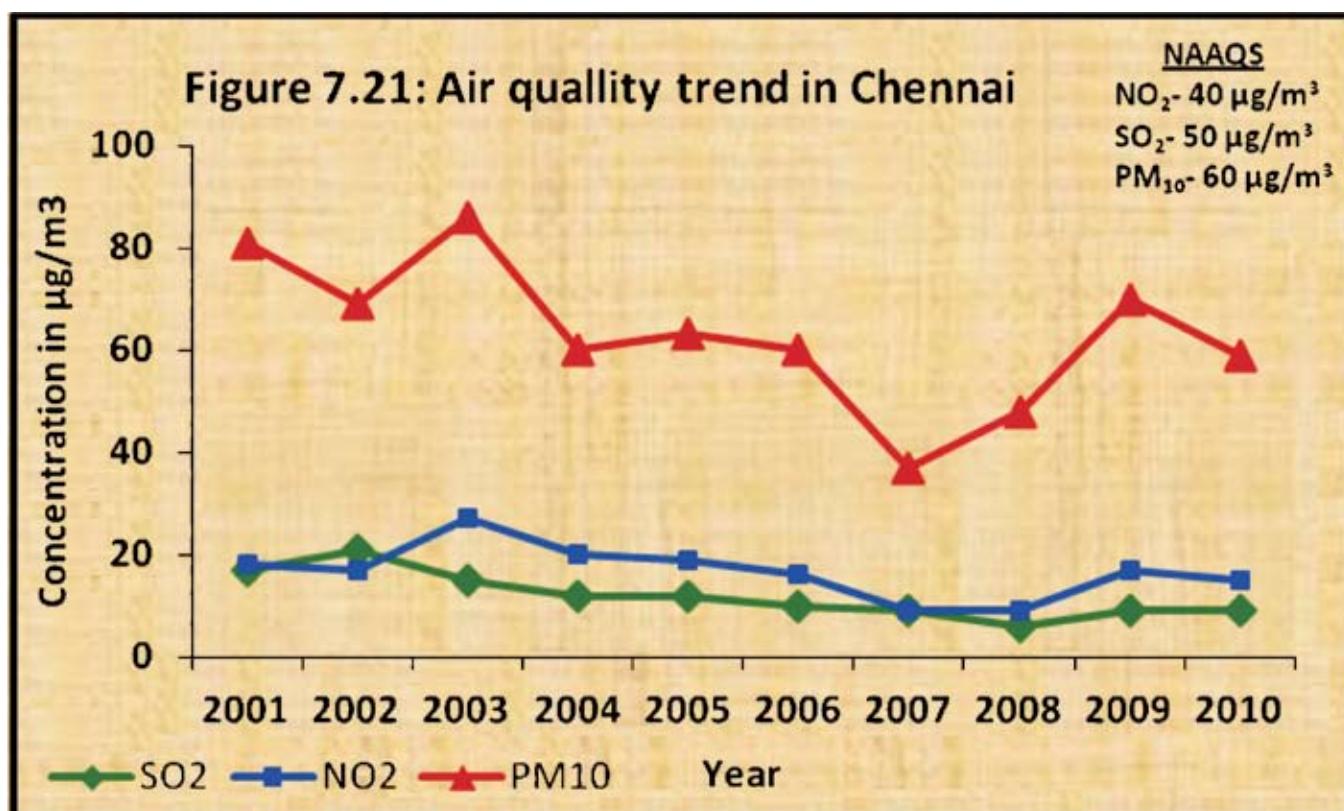
### 6.3.20 KOCHI

State	Kerala
Location	9°58'N to 9.967°N and 76°13'E to 76.217°E
Area	2408 km <sup>2</sup>
Population	1,355,972
Climate	Tropical monsoon climate. From June through September, the south-west monsoon brings in heavy rains as Kochi lies on the windward side of the Western Ghats. From October to December, Kochi receives rain from the northeast monsoon, as it lies on the leeward side.  Temperature: maximum of 40 °C while in winter it is around 25°C  Rainfall: annual rainfall is about 310 cm
Geography	To the west lies the Arabian Sea, and to the east are estuaries drained by perennial rivers originating in the Western Ghats. Much of Kochi lies at sea level, with a coastline of 48 km. Soil consists of sediments such as alluvium, teri's, brown sands, etc. Hydromorphic saline soils are also found in the areas surrounding the backwaters. Predominant rock types found here are <u>Archaean</u> -basic dykes, Charnockites and Gneisses.
Industries	Cashew and other food products, Cochin Spices, Coir products, Chemicals and Agro products, Chemicals, Handloom, Handicrafts, Rubber, Electric, Electronic appliances, Transformers, Telephone cables, Ceramics, Tiles, Drugs, Chemicals, Paints, Newsprint, Refinery and wood craft industries.
Air quality stations	7 (4 residential, 3 industrial)
Air quality trend	Analysis of nine year air quality data of PM <sub>10</sub> shows an increasing trend with an abrupt increase after 2007. SO <sub>2</sub> and NO <sub>2</sub> is more or less stable after 2006 and are within NAAQS (Figure 7.20).



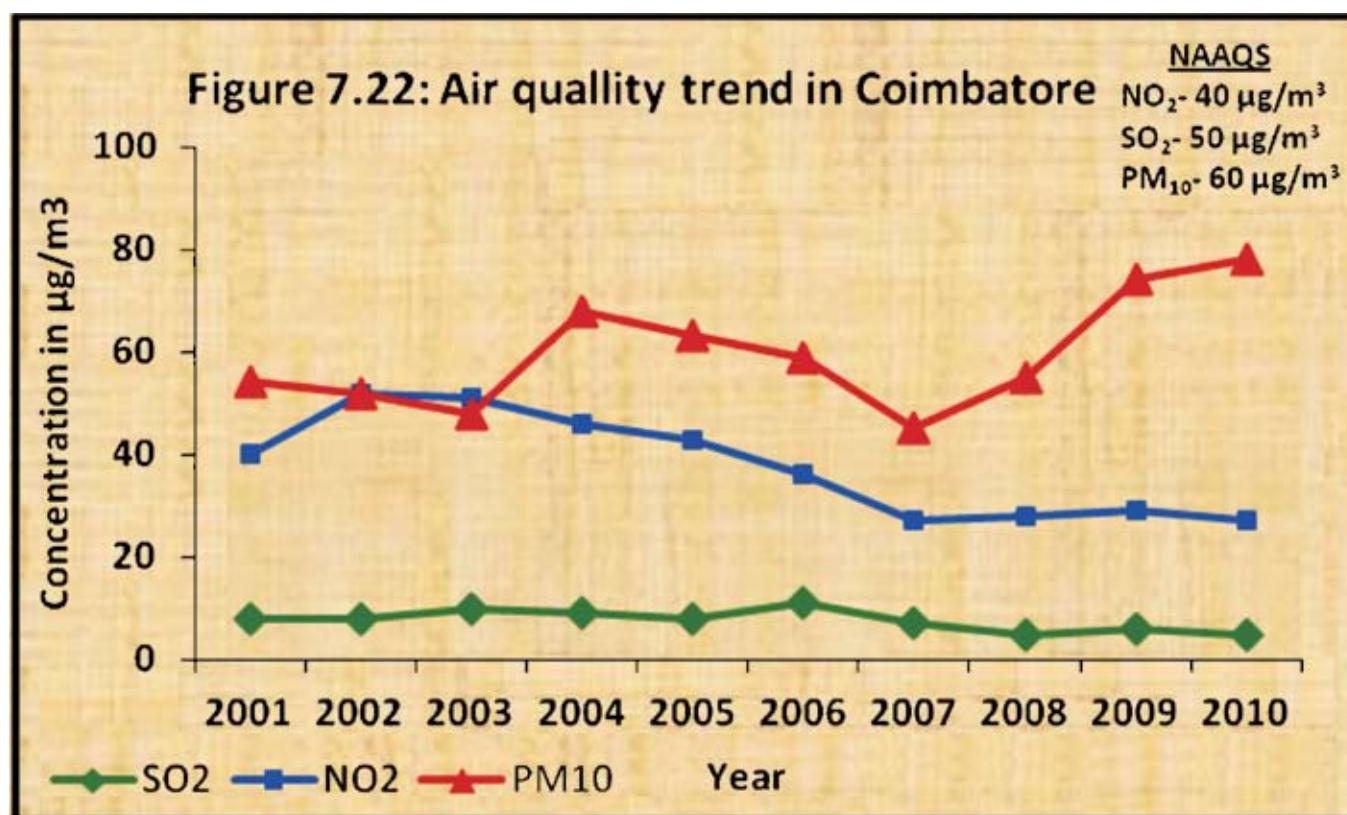
### 6.3.21 CHENNAI

State	Tamilnadu
Location	13°04' N and 80°17'E. Average elevation is around 6.7 metres
Area	173 km <sup>2</sup>
Population	64,24,624
Climate	<p>Tropical wet and dry climate. The weather is hot and humid for most of the year. The city gets most of its seasonal rainfall from the north-east monsoon winds, from mid-October to mid-December. Cyclones in the Bay of Bengal sometimes hit the city. T</p> <p>Temperature: 24.3<sup>0</sup> C (min) to 32.9 <sup>0</sup>C (max)</p> <p>Rainfall: annual rainfall in the region is the range from 1286 to 1233 mm</p>
Geography	Situated on the eastern coastal plains. Drained by Cooum River (or Koovam) through the centre, Adyar River to the south and Kortalaiyar on the northern fringes. Soil is mostly clay, shale and sandstone.
Industries	Chemicals, oil refinery, oil storage tanks motors, cycles, rubber factory, surgical instruments factory, refinery, food factories, beverage factories, wood, paper and paper products, machinery tool industries, transport equipments, electrical machinery industries
Air quality stations	6 (2 residential, 4 industrial)
Air quality trend	Analysis of nine year air quality data of PM <sub>10</sub> shows an increasing trend with an abrupt increase after 2007. SO <sub>2</sub> and NO <sub>2</sub> is more or less stable after 2006 and are within NAAQS (Figure 7.21).



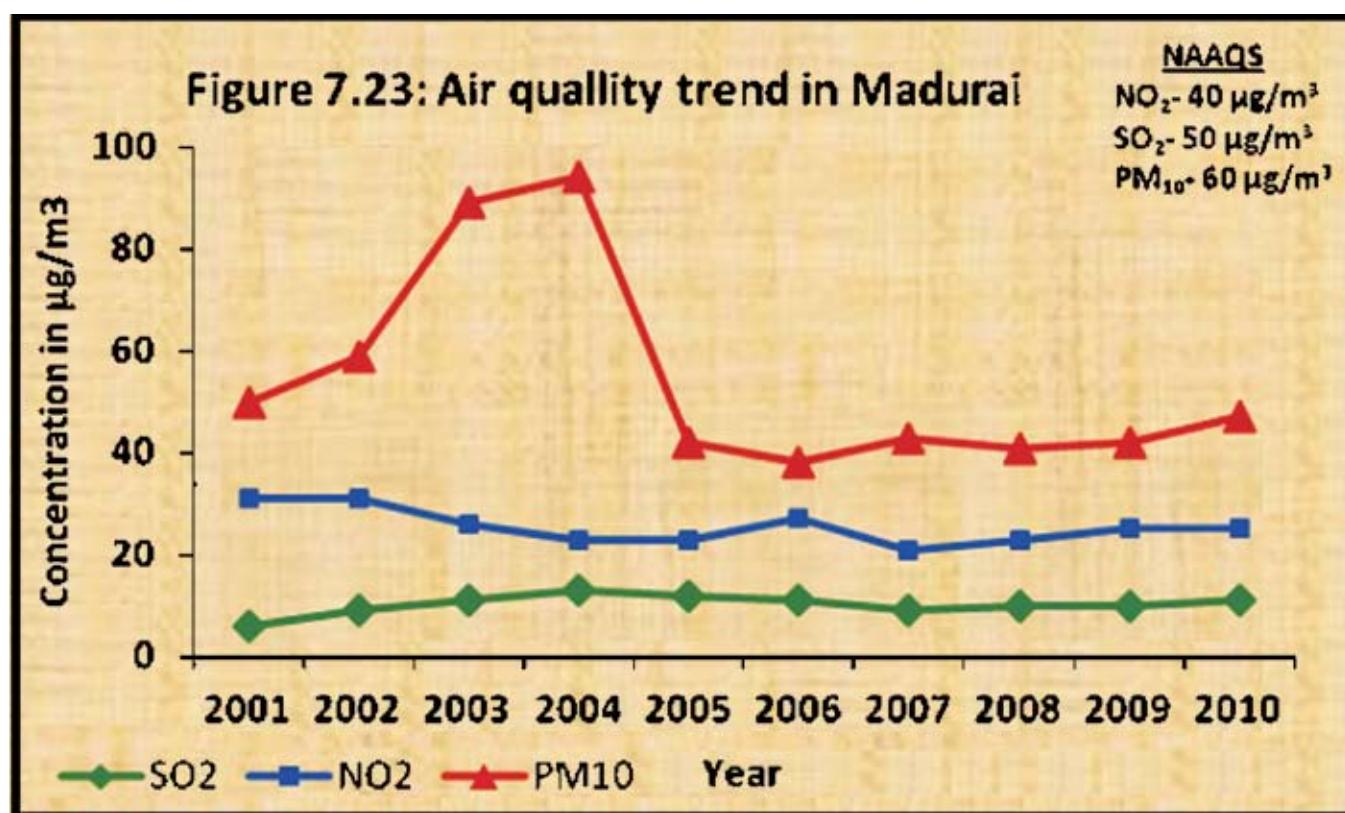
### 6.3.22 COIMBATORE

State	Tamilnadu
Location	11°00' N and 77°00' E, Elevation of about 398 meters
Area	140 km <sup>2</sup>
Population	14,46,034
Climate	Tropical wet and dry climate. Regular monsoon starts from October lasting till early November brought about by the retreating North-eastern monsoon. Temperature: The mean maximum and minimum temperatures during summer and winter varies between 35°C to 18°C. Rainfall: annual rainfall of the district is 647 mm
Geography	The soil is predominantly black, which is suitable for cotton cultivation, but it also has some red loamy soil. Falls under the Class III/IV Seismic Zone
Industries	Textile mills, engineering industries, automobile components, washing machines, wet grinders, general engineering industries, food processing units and readymade garments. Large number of small-scale industries also flourish
Air quality stations	3 (2 residential, 1 industrial)
Air quality trend	Analysis of nine year air quality data of PM <sub>10</sub> shows fluctuating trend with an abrupt increase after 2007. NO <sub>2</sub> shows a decline over the years and SO <sub>2</sub> is stable and within NAAQS (Figure 7.22).



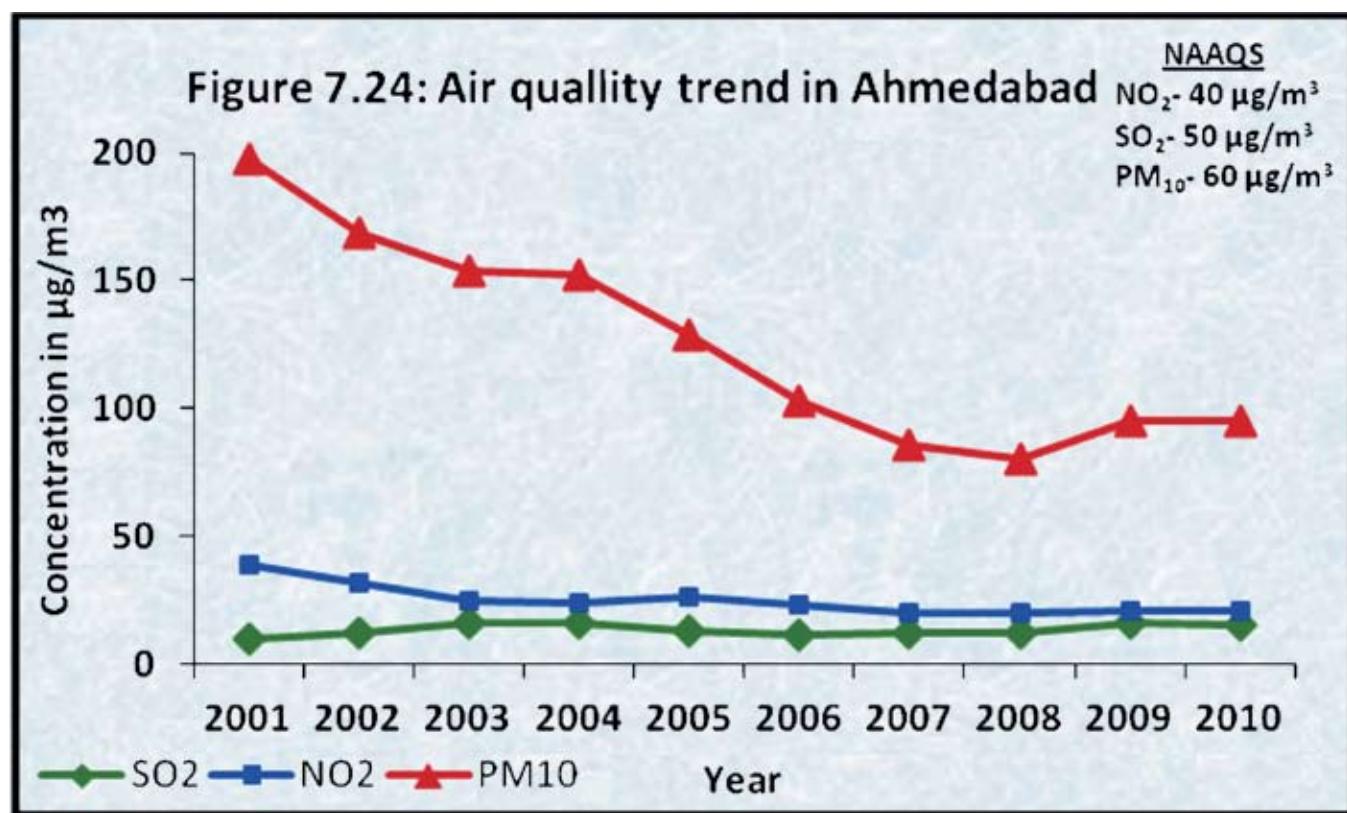
### 6.3.23 MADURAI

State	Tamilnadu
Location	9°58' N and 78°10' E, elevation of 101 meters above mean sea level
Area	140 km <sup>2</sup>
Population	11, 94,665
Climate	Hot and humid, Madurai has the typical climate of the rest of the Deccan plateau. Normally, Sub tropical climate prevails over the city without any sharp variation. four distinct seasons, viz., and South West monsoon, North East Monsoon, Winter Season and Hot Summer Season Temperature: Temperatures during summer reach a maximum of 40 and a minimum of 26.3 °C, though temperatures over 43 °C are not uncommon. Winter temperatures range between 29.6 and 18 °C. Rainfall: average annual rainfall of the city is 867 mm
Geography	Situated on the banks of the River Vaigai
Industries	Textile mills, engineering industries, mechanical industries, electrical and electronic appliances, steel rolling mills and small scale industries like Food products, readymade garments, wooden industries, printing, moulding industries predominate in the area.
Air quality stations	3 (2 residential, 1 industrial)
Air quality trend	Analysis of nine year air quality data of PM <sub>10</sub> shows fluctuating trend. NO <sub>2</sub> shows a decline over the years and SO <sub>2</sub> is stable and within NAAQS (Figure 7.23).



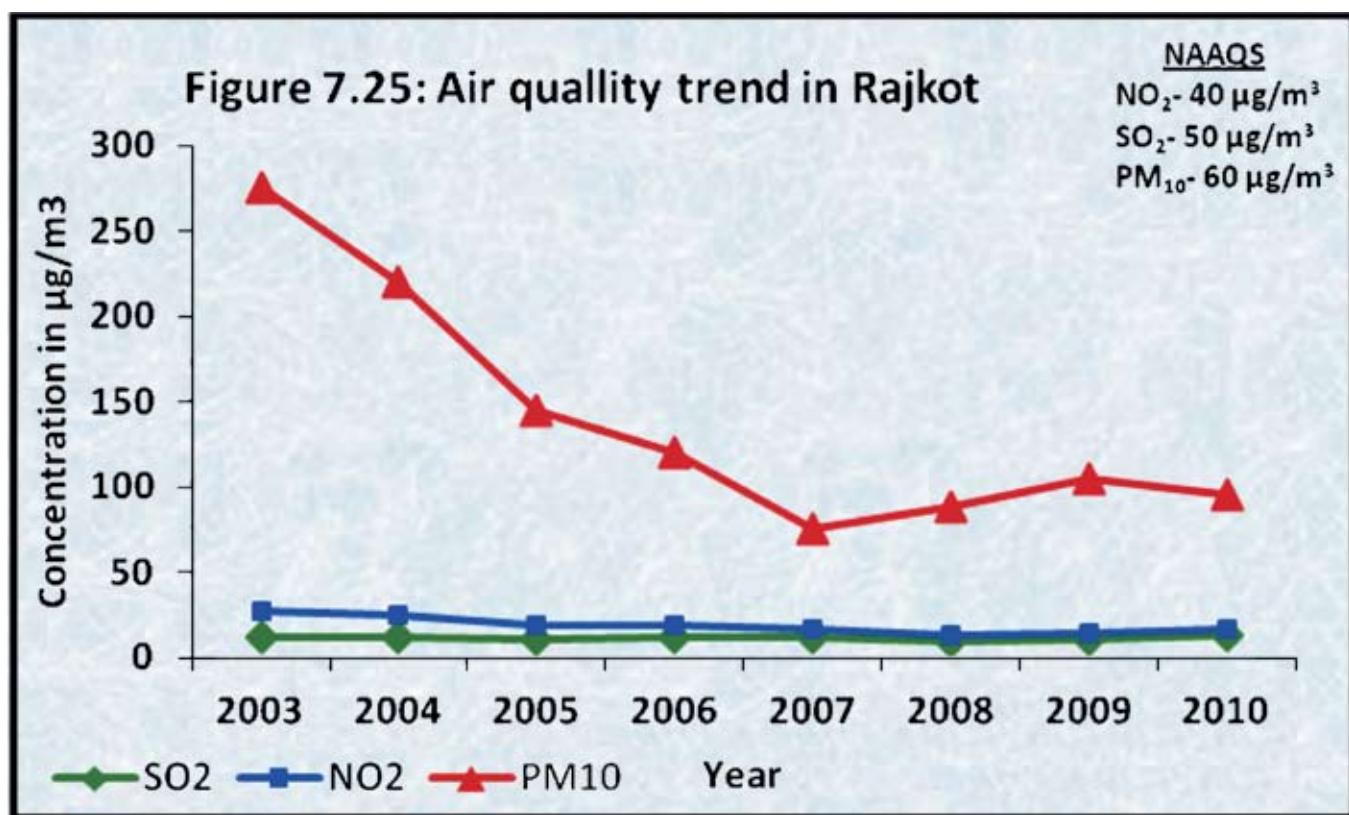
### 6.3.24 AHMEDABAD

State	Gujarat
Location	23°02' N and 72°35' E, elevation of 53 metres
Area	300 km <sup>2</sup>
Population	35,20,085
Climate	<p>Semi-arid climate. There are three main seasons: summer, monsoon and winter. Aside from the monsoon season, the climate is dry. The southwest monsoon brings a humid climate from mid-June to mid-September.</p> <p>Temperature: May is the hottest month with mean daily maximum temperature of 41.3°C and occasionally rises up to over 46°C. January is the coldest month with the mean daily temperature of 29°C.</p> <p>Rainfall: average annual rainfall for this period was 732 mm</p>
Geography	The city sits on the banks of the River Sabarmati, in north-central Gujarat. falls under seismic zone-III. Area forms part of the Cambay sedimentary basin, and is underlain by post-Miocene alluvium, both aeolian and fluvial, composed of sand, silt, gravel and clay.
Industries	Textile mill, chemicals and pharmaceuticals industry.
Air quality stations	6 (4 residential, 2 industrial)
Air quality trend	Analysis of nine year air quality data of PM <sub>10</sub> shows a declining trend with a slight increase during 2009. Both SO <sub>2</sub> and NO <sub>2</sub> are more or less stable (Figure 7.24).



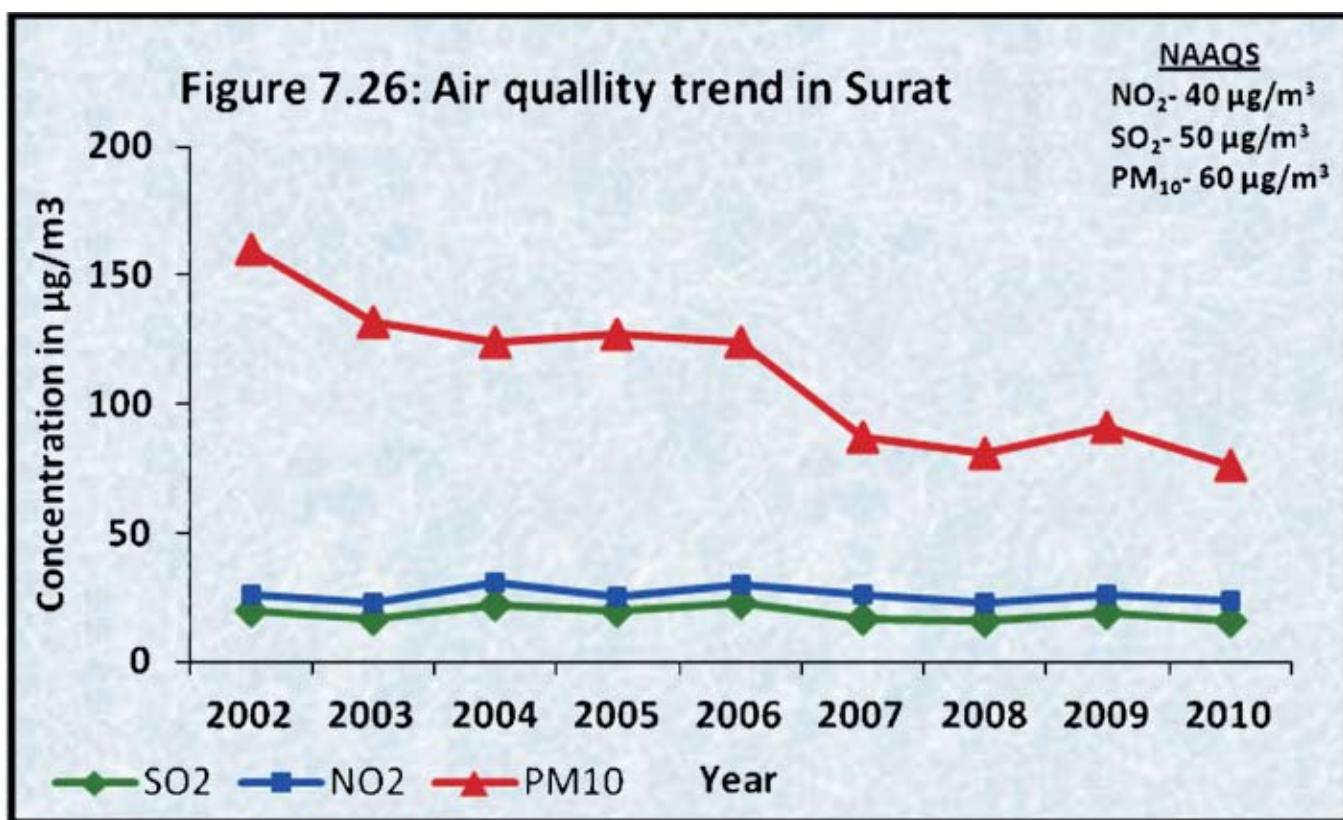
### 6.3.25 RAJKOT

State	Gujarat
Location	22°18' N and 70°47' E, elevation of 134 m (439 feet).
Area	104.86 km <sup>2</sup>
Population	10,02,160
Climate	<p>Semiarid climate with hot dry summers from mid-March to mid-June and the wet monsoon season from mid-June to October. The cyclones generally occur in the Arabian Sea during the months after the rainy season.</p> <p>Temperature: average maximum and minimum temperatures recorded over the last 40 years are 43.5 °C and 24.2 °C respectively</p> <p>Rainfall: average annual rainfall is observed about 500 mm in the area</p>
Geography	Dharangadhra sand stones (Upper Jurassic to Lower Cretaceous), Deccan Trap (Upper Cretaceous to Lower Eocene), Fluviomarine alluvium and Milliolite limestone (Quaternary to Upper Tertiary). However, major part of the area is constituted of Basaltic lava flows.
Industries	Bearings, diesel engines, kitchen knives and other cutting appliances, watch parts (cases & bracelets), automotive parts, forging industry, casting industry, machine tools, share market and software development, textile mill There are eight industrial areas/estates functioning in the city. The total number of small scale industries registered is about 12000.
Air quality stations	2 (1 residential, 1 industrial)
Air quality trend	Analysis of nine year air quality data shows a more or less stable trend for SO <sub>2</sub> and NO <sub>2</sub> . As for PM <sub>10</sub> upto 2007 a declining trend is seen whereas a slight increasing trend is seen after 2007 (Figure 7.25).



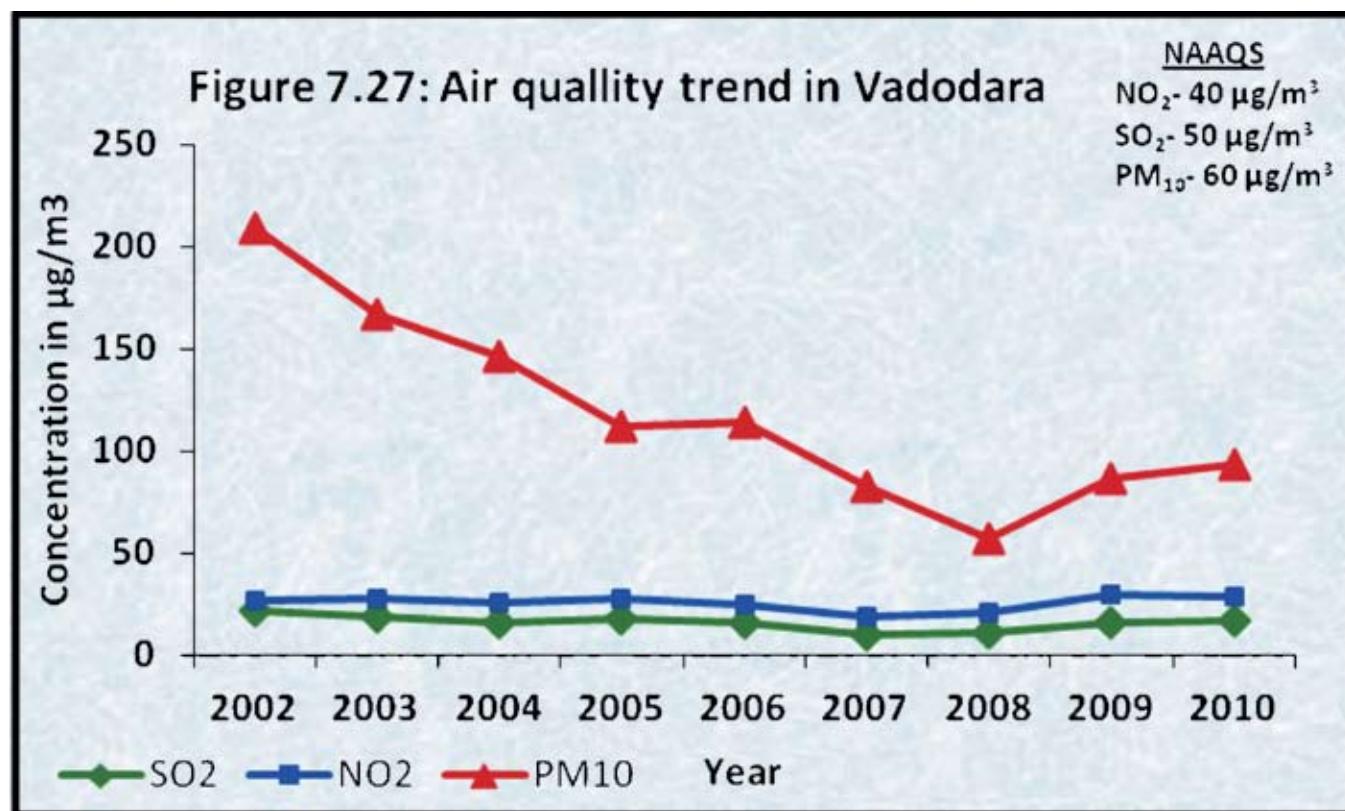
### 6.3.26 SURAT

State	Gujarat
Location	21°10' N and 72°50' E, average elevation of 13 meters
Area	112.27 km <sup>2</sup>
Population	28,11,466.
Climate	Tropical monsoon climate, moderated strongly by the Arabian Sea. The summer begins in early March and lasts till June. April and May are the hottest months, the average temperature being 30 °C. Monsoon begins in late June. Very often heavy monsoon rain brings floods in the Tapi basin area. Temperature: temperature of the city varies from 12°C to 31°C, while it varies from 24°C to 42°C Rainfall: 931 mm
Geography	Situated on the left bank of the <u>Tapti River</u> , 14 miles from its mouth soil of the area is of black cotton type upto 1.5 m followed by yellow soil and silt upto 10 m. Below 10 m depth, soft rocks are available. There is no signature of hardrock in the area.
Industries	Production of <u>synthetic fibers</u> and man-made fabrics, <u>diamond-polishing industry</u> , , steel. The total number of industries registered is about 45000.
Air quality stations	3 (2 residential, 1 industrial)
Air quality trend	Analysis of nine year air quality data shows a more or less stable trend for SO <sub>2</sub> and NO <sub>2</sub> . As for PM <sub>10</sub> upto 2007 a declining trend is seen whereas a slight increasing trend is seen after 2007 (Figure 7.26).



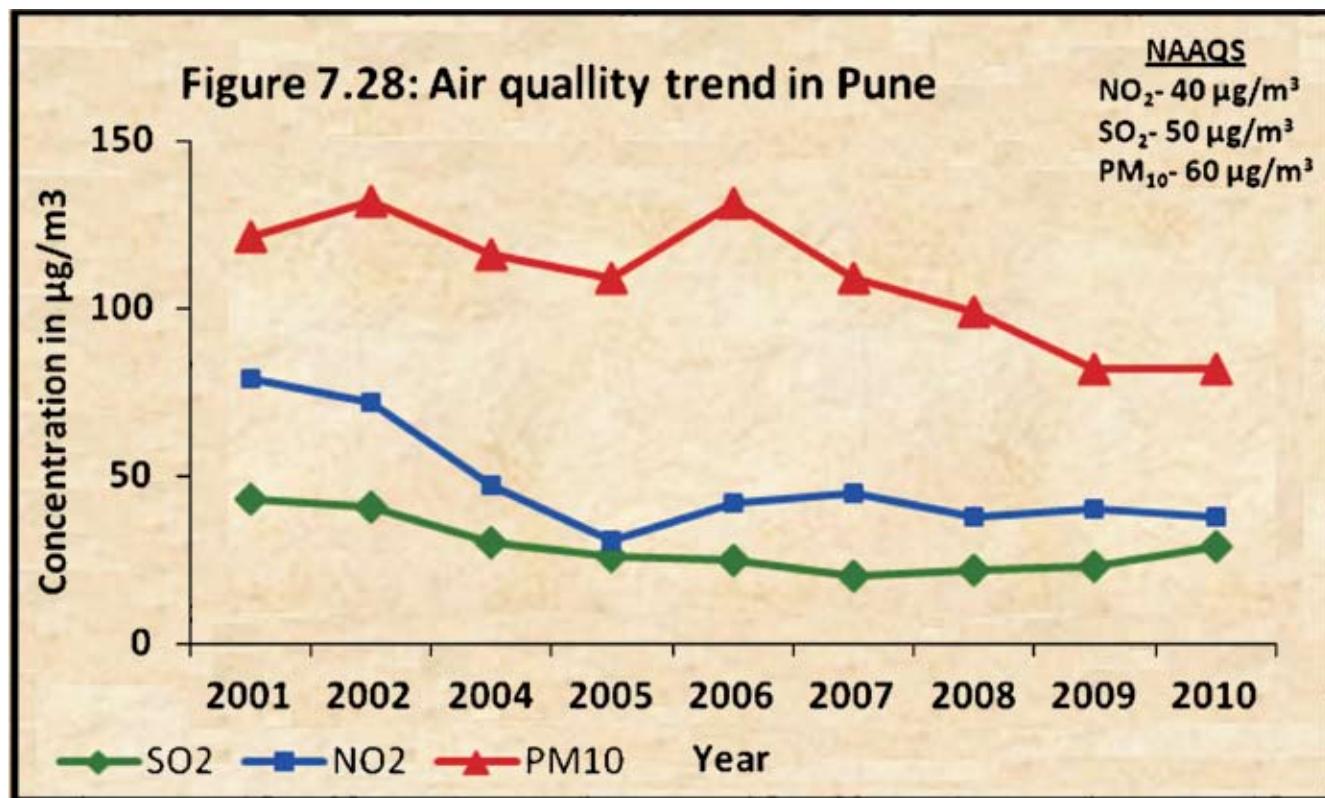
### 6.3.27 VADODARA

State	Gujarat
Location	22°18' N and 73°16' E, elevation of 39 metres (123 feet)
Area	140 km <sup>2</sup>
Population	14,92,398
Climate	Tropical savanna climate. There are three main seasons: Summer, Monsoon and Winter. Aside from the monsoon season, the climate is dry. Temperature: The temperature of the city varies from 8°C to 46°C Rainfall: 900 mm
Geography	Basement rocks, exposed in northern and eastern parts, had been controlled by the Precambrian orogenies (Arvalli and Delhi cycles), and the older crystalline rocks ideally shows folds, faults and magmatism related to the two orogenies. The city sits on the banks of the River Vishwamitri, in central Gujarat, Mahi & Narmada Rivers. Falls under seismic zone-III, in a scale of I to V (in order of increasing proneness to earthquakes).
Industries	Petrochemicals, engineering, pharmaceuticals, plastics and Forex. The total number of industries registered is about 7500, out of which 6000 are functioning. There are about 2200 industries under GIDC in Makarpura.
Air quality stations	4 (3 residential, 1 industrial)
Air quality trend	Analysis of nine year air quality data shows a more or less stable trend for SO <sub>2</sub> and NO <sub>2</sub> . As for PM <sub>10</sub> upto 2008 a declining trend is seen whereas a slight increasing trend is seen after 2008 (Figure 7.27).



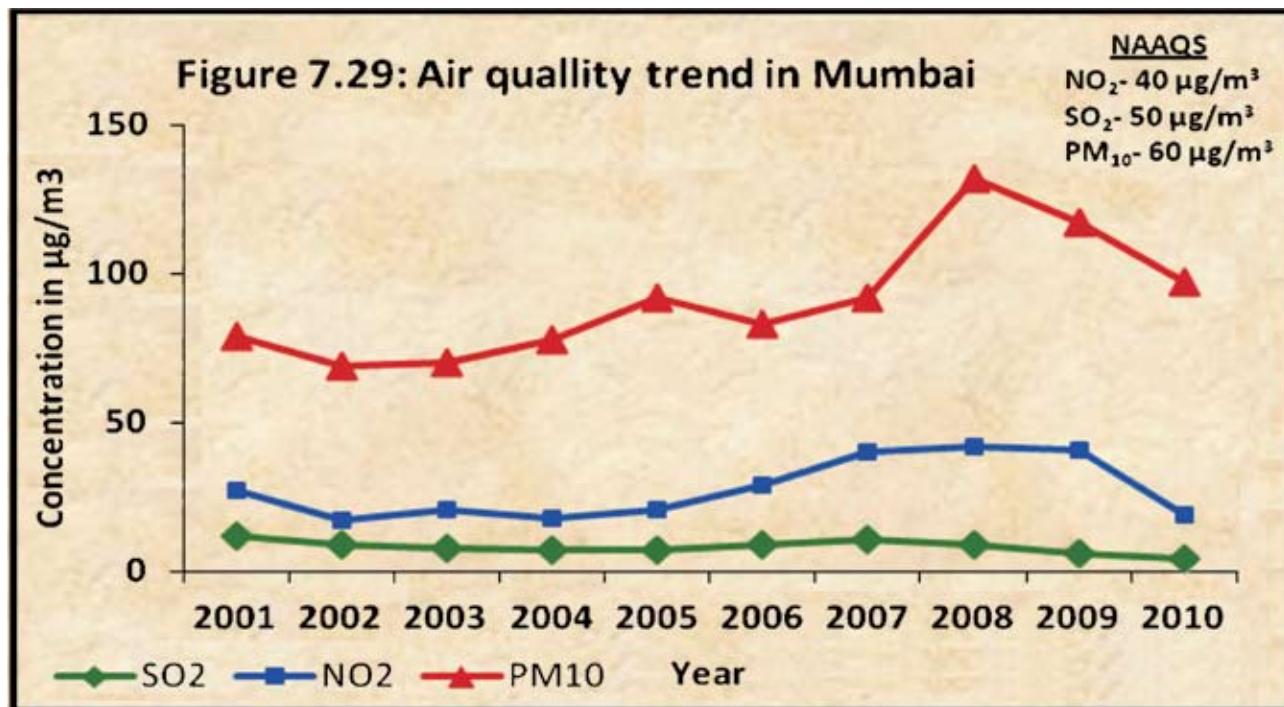
### 6.3.28 PUNE

State	Maharashtra
Location	18°18'36" N and 73°33' E, 560 m (1,840 ft) above sea level
Area	15,642 km <sup>2</sup>
Population	37,55,525
Climate	Tropical wet and dry climate. Three distinct seasons: summer, monsoon and winter. The height above sea level and the leeward location with reference to the Western ghats have made the city climate moderate and salubrious. Temperature: mean summer maximum and the minimum temperatures are 37° and 23° C respectively. The same for the cold season are 30 and 12°C respectively relative humidity ranges from 36% in March to 81% in August Rainfall: average rainfall is about 70 cm in just four months from June to September
Geography	Lcated on the western margin of the Deccan plateau on the leeward side of the Sahyadri mountain range, which form a barrier from the Arabian sea. At the confluence of the Mula and Mutha rivers. The Pavana and Indrayani rivers, tributaries of the Bhima river, traverse the northwestern outskirts of metropolitan Pune. Underlain by basaltic lava flows (Pahoehoe and AA) of upper cretaceous econe age associated with basic intrusives. The soil texture contains alluvial depositees of sand, gravels, fine silts and clays along the bank of major rivers.
Industries	One of the world's three largest two-wheeler manufacturers. Engineering, electronic and electrical industries culture.
Air quality stations	3 (2 residential, 1 industrial)
Air quality trend	Analysis of nine year air quality data shows a more or less stable trend for SO <sub>2</sub> and NO <sub>2</sub> . As for PM <sub>10</sub> a declining trend is seen. (Figure 7.28).



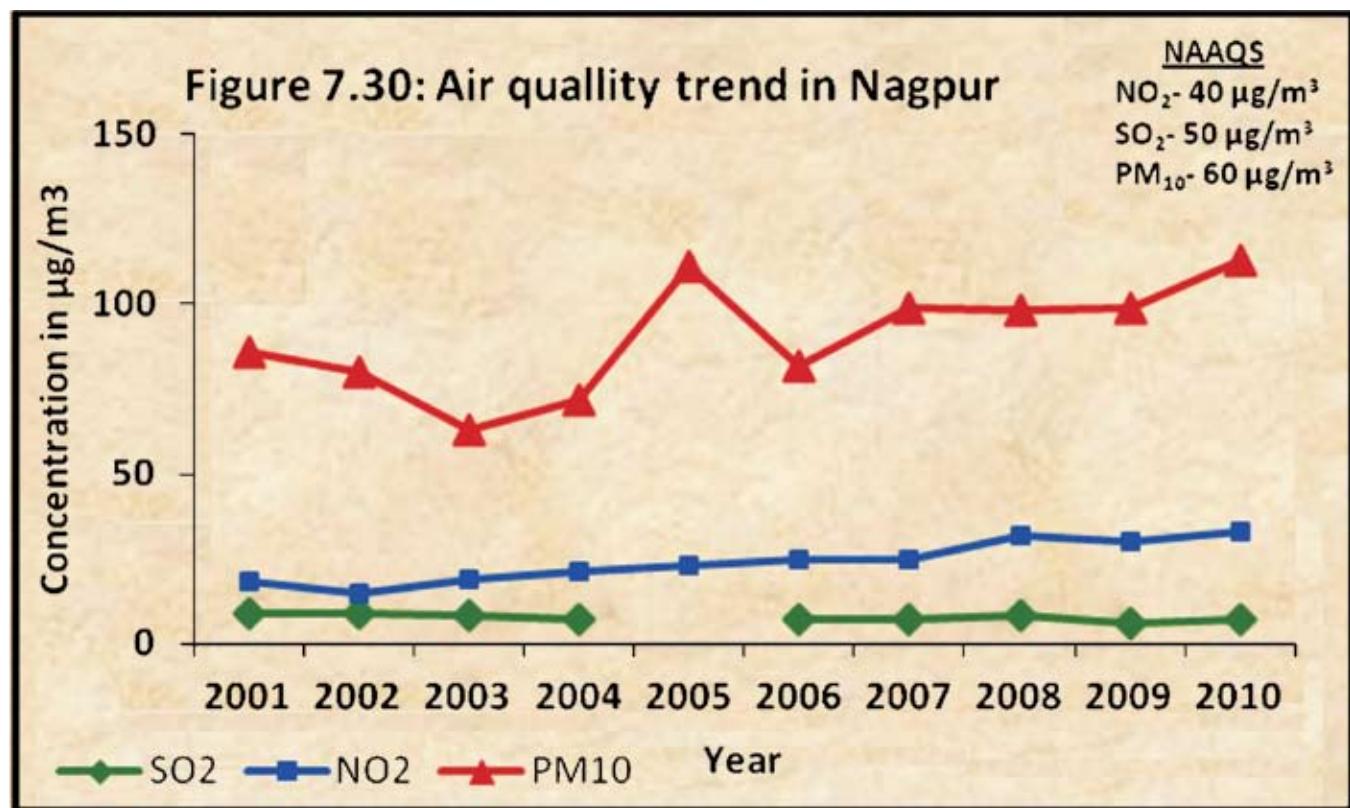
### 6.3.29 MUMBAI – commercial capital

State	Maharashtra
Location	18°55' N and 72°54' E, elevation of 14 m (46 ft)
Area	603.4 km <sup>2</sup> (233 sq mi) <sup>1</sup>
Population	1,40,00,000 lacs
Climate	<p>Tropical climate, specifically a tropical wet and dry climate with seven months of dryness and peak of rains in July. The cold season from December to February is followed by the summer season from March to June. The period from June to about the end of September constitutes the south-west monsoon season, and October and November form the post-monsoon season.</p> <p>Temperature: average maximum temperature is 31.2 °C (88.2 °F), while the average minimum temperature is 23.7 °C (74.7 °F)</p> <p>Rainfall: average total annual rainfall is 2,146.6 millimetres (84.51 in) for the Island City, and 2,457 millimetres (96.73 in) for the suburbs</p>
Geography	Mumbai lies at the mouth of the Ulhas River on the western coast of India, in the coastal region known as the Konkan. Three small rivers, the Dahisar River, Poinsar (or Poisar) and Oshiwara (or Oshiwara) originate within the park, while the polluted Mithi River originates from Tulsi Lake and gathers water overflowing from Vihar and Powai Lakes. The coastline of the city is indented with numerous creeks and bays, stretching from Thane creek on the eastern to Madh Marve on the western front. The eastern coast of Salsette Island is covered with large mangrove swamps, rich in biodiversity, while the western coast is mostly sandy and rocky. Soil cover in the city region is predominantly sandy due to its proximity to the sea. In the suburbs, the soil cover is largely alluvial and loamy. The underlying rock of the region is composed of black Deccan basalt flows, and their acidic and basic variants It is a seismically active zone
Industries	port and shipping
Air quality stations	(residential, industrial)
Air quality trend	Analysis of nine year air quality data with respect to PM10 shows an increasing trend till 2008 and slight decrease in 2009. NO <sub>2</sub> also showed an increasing trend but SO <sub>2</sub> showed a decreasing trend. (Figure 7.29).



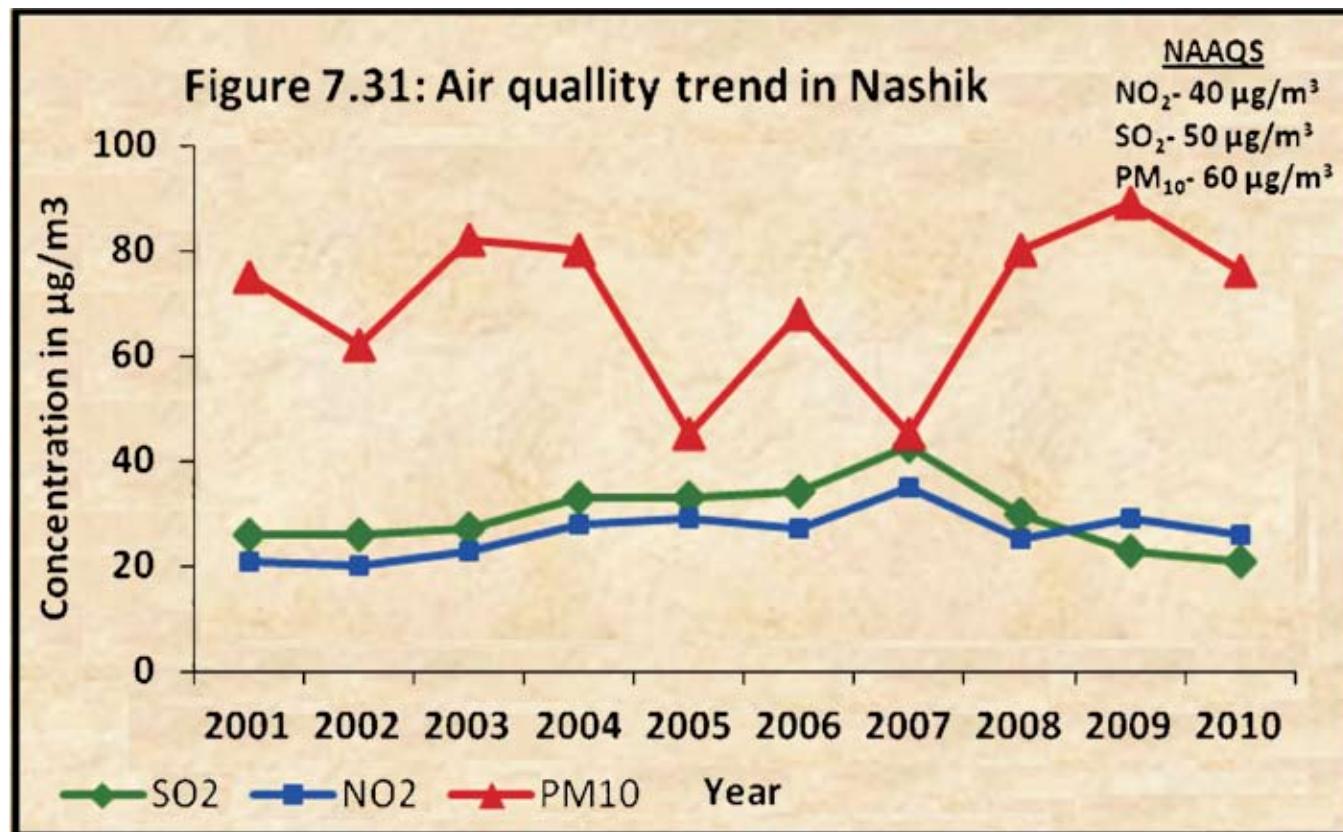
### 6.3.30 NAGPUR

State	Maharashtra
Location	21°5'24" N and 79°5'24"E, mean altitude of 310 meters above sea level
Area	218 km <sup>2</sup>
Population	21,22,965
Climate	Tropical wet and dry climate with dry conditions prevailing for most of the year. Summers are extremely hot lasting from March to June, with maximum temperatures occurring in May. Winter lasts from November to January Temperature: mean daily temperature at 12.1 °C and daily maximum temperature being 28.7 °C. Rainfall average annual rainfall being 1178.7 mm
Geography	Nagpur lies on the Deccan plateau of the Indian Peninsula. The underlying rock strata is covered with alluvial deposits resulting from the flood plain of the Kanhan River. In some places these give rise to granular sandy soil. In low lying areas which are poorly drained, the soil is alluvial clay with poor permeability characteristics. In the eastern part of city crystalline metamorphic rocks such as gneiss, schist and granites are found, while in the northern part yellowish sand stones and clays of the lower Gondwana formations are found. <sup>[1]</sup>
Industries	Engineering Works, Saw mills, Rolling mills, Ayurvedic medicines. Different types of small scale and cottage units.
Air quality stations	6 (4 residential, 2 industrial)
Air quality trend	Analysis of nine year air quality data with respect to PM10 shows an increasing trend till 2008 and slight decrease in 2009. NO <sub>2</sub> also showed an increasing trend but SO <sub>2</sub> showed a decreasing trend. (Figure 7.30).



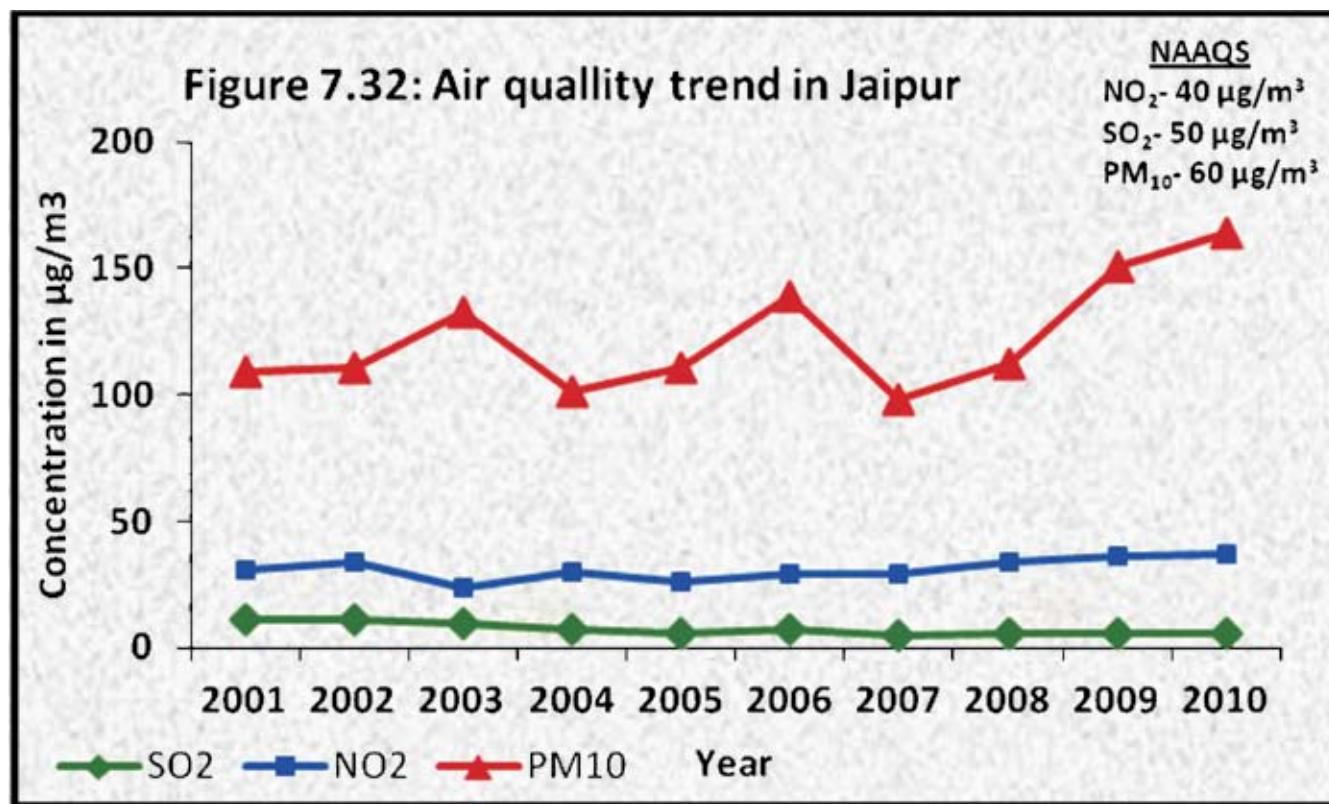
### 6.3.3 I NASHIK

State	Maharashtra
Location	20°1'12" N and 73°30' E, 600m (1968 ft) from the mean sea level
Area	259.13 km <sup>2</sup>
Population	11,52,048
Climate	Semi-arid climate. The period from June to September is the (South West) Monsoon Season. Mild, dry winter from November to February, with warm days and cool nights, although occasional cold waves can dip temperatures. Temperature: summer and winter temperatures ranged 22 to 43°C and 20 to 3°C respectively Rainfall: average annual rainfall is about 700 mm Relative humidity is maximum 62% and minimum 43.65%.
Geography	The river Godavari originates from Trimbakeshwar flows through various parts of the city. Lies on western edge of the Deccan Plateau which is a volcanic formation. The soil here is primarily black which is favorable for agriculture. Occupied by Deccan basaltic rocks.
Industries	Aircraft manufacturing plant, automobile, pharmaceuticals, electricals, steel, nation's currency printer
Air quality stations	3 (2 residential, 1 industrial)
Air quality trend	Analysis of nine year air quality data with respect to PM10 shows an increasing trend till 2008 and slight decrease in 2009. NO <sub>2</sub> also showed an increasing trend but SO <sub>2</sub> showed a decreasing trend. (Figure 7.31).



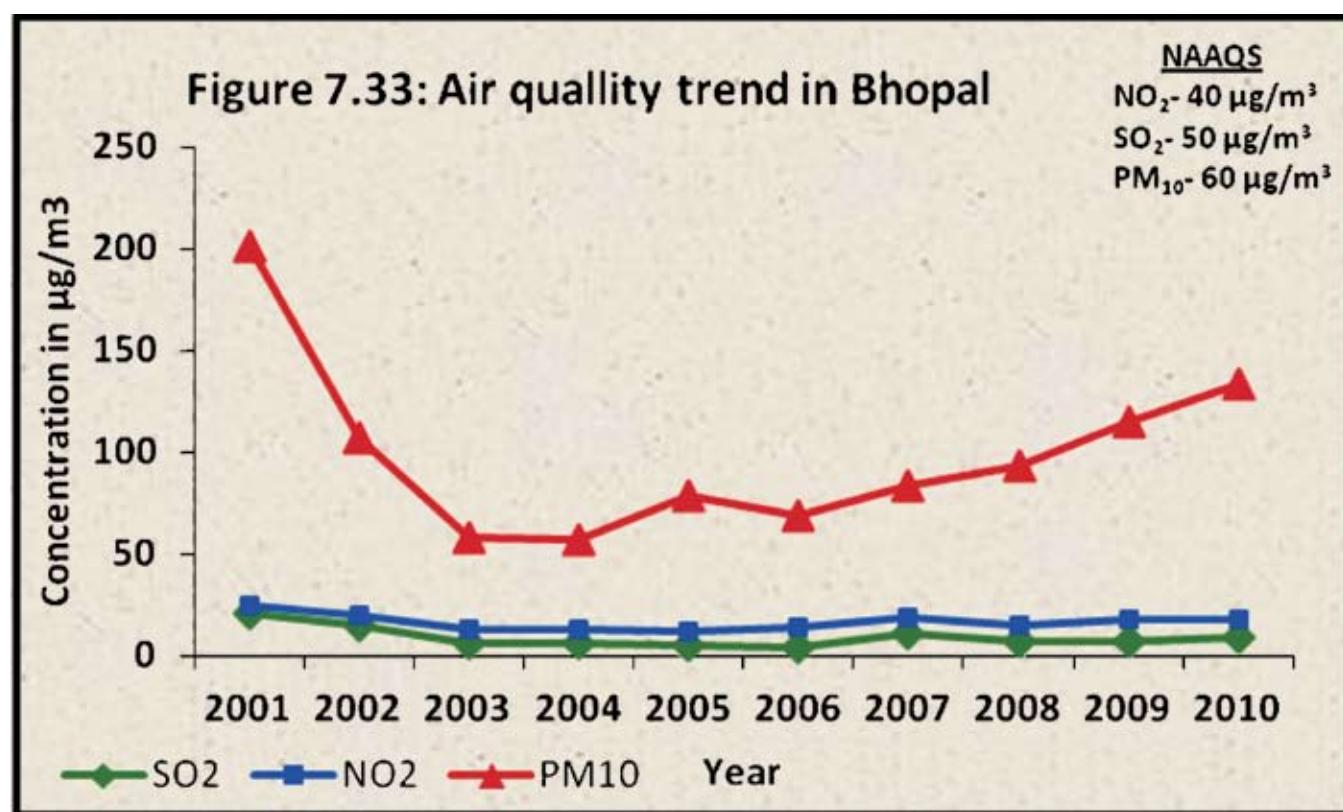
### 6.3.32 JAIPUR

State	Rajasthan
Location	26°33' N and 75°31'12"E , average elevation of 431 metres (1417 ft)
Area	230 km <sup>2</sup>
Population	23,24,319
Climate	Semi-arid climate Temperatures remain relatively high throughout the year. During the monsoon there are frequent, heavy rains and thunderstorms. Winter months of November to February are mild and pleasant, There are however occasional cold waves that lead to temperatures near freezing is dry and healthy and is subjected to extremes of cold and heat at various places. Temperature: minimum and maximum temperatures are 3°C and 45°C respectively while the mean temperature is 24°C. Rainfall annual rainfall in the district is 548 mm
Geography	Oldest groups of rock in the district are schist, gneisses, migmatite and quartzite of Pre-Aravalli, which are considered to be nearly 2,500 million year old. These rocks are covered under a mantle of sand and alluvium, of recent to sub recent age. The major rivers passing through the Jaipur district are <u>Banas</u> and <u>Banganga</u> . Ground water resources to the extent of about 28.65 million cubic meter are available in the district.
Industries	Marbel units, Readymade garments, Rolling mills, Chemical units, Printing units, Powerloom units, Gems and Jewelry unit, Casting units, Vanaspati oil mills, Precious and semi precious stone cutting units, Leather units and Electronics industries. The total number of registered small scale and artizen units in the city is 16799.
Air quality stations	6 (4 residential, 2 industrial)
Air quality trend	Analysis of nine year air quality data with respect to PM10 shows an increasing trend till 2008 and slight decrease in 2009. NO2 also showed an increasing trend but SO2 showed a decreasing trend. (Figure 7.32).



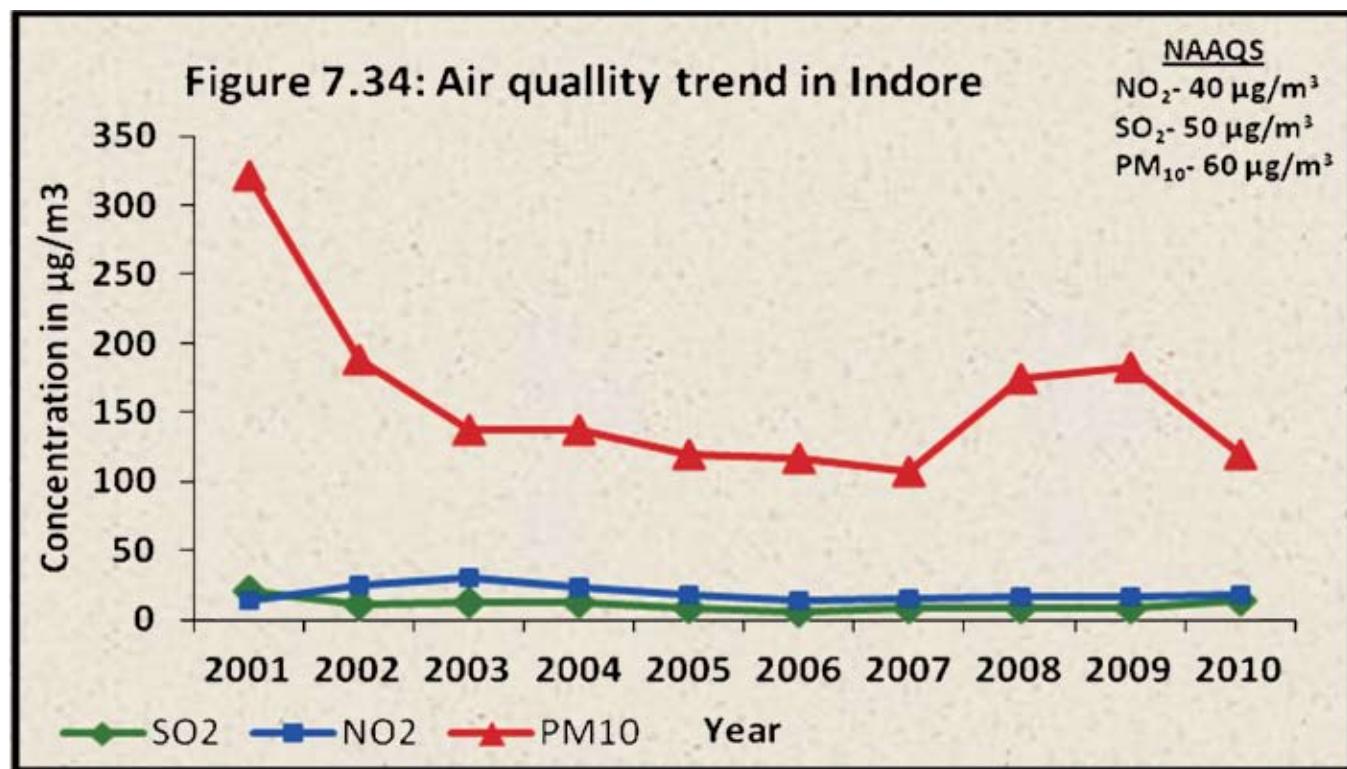
### 6.3.33 BHOPAL

State	Madhya Pradesh
Location	23°9'36" N and 77°21'36"E, average elevation of 499 metres (1637 ft)
Area	286 km <sup>2</sup>
Population	14,54,830
Climate	<p>Humid subtropical climate, with mild, dry winters, a hot summer and a humid monsoon season, starting in late June and ends in late September with frequent thunderstorms and flooding.. The winter peaks in January when temperatures may drop close to freezing on some nights.</p> <p>Temperature: Summers start in late March and go on till mid-June, the average temperature being around 30 °C (86 °F) Winters in Bhopal are mild, sunny and dry, with average temperatures around 18 °C (64 °F)</p> <p>Rainfall The normal annual rainfall of Bhopal city is about 1260 mm</p>
Geography	Located in upper limit of the Vindhya mountain ranges, on the <u>Malwa</u> plateau. The area is occupied alluvial formations
Industries	Engineering Works, Bewerage, Bottling, Paints, Ancillary to BHEL, Electrical, Mechanical Engineering, Heavy fabrication factories, Glass fibre industries, Wooden, Saw mills, Food products, Automobiles and Agricultural equipments. The total number of registered units (small scale and cottage) in the city is 11960
Air quality stations	4 (3 residential, 1 industrial)
Air quality trend	Analysis of nine year air quality data with respect to PM <sub>10</sub> shows an increasing trend till 2008 and slight decrease in 2009. NO <sub>2</sub> also showed an increasing trend but SO <sub>2</sub> showed a decreasing trend. (Figure 7.33).



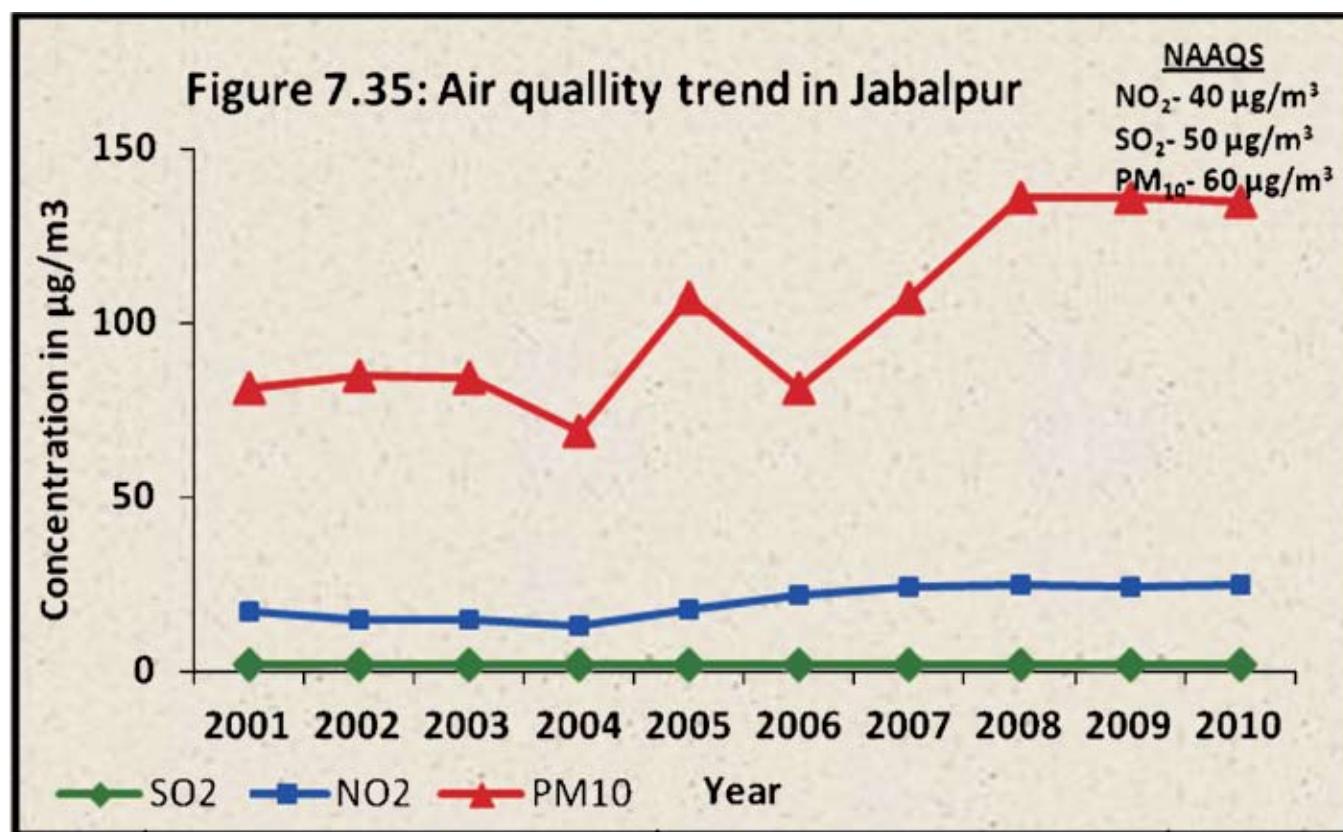
### 6.3.34 INDORE

State	Madhya Pradesh
Location	22°26'24" N and 75°30'E, elevation of 550 metre above sea level
Area	130 km <sup>2</sup>
Population	16,39,044
Climate	<p>Tropical wet and dry climate and a humid subtropical climate. Three distinct seasons are observed: summer, monsoon and winter. Summers start in mid-March and can be extremely hot in April and May. Due to Indore's location on the southern edge of the Malwa Plateau, a cool breeze in the evenings makes summer nights quite pleasant.</p> <p>Temperature: Average Summer temperatures may go as high as 42-44.c (100.4 °F) but humidity is very low. The monsoon season starts in late June, with temperatures averaging around 26 °C (79 °F), with sustained, torrential rainfall and high humidity. Winters start in mid-November and are dry, mild and sunny. Temperatures average about 4–15 °C (39–59 °F), but can fall close to freezing on some nights.</p> <p>Rainfall: Average rainfall of Indore district is about 980 mm</p>
Geography	Located in the southern edge of the <u>Malwa</u> plateau, on the Saraswati and Khan rivers, which are tributaries of the <u>Shipra</u> River. Isolated patches of alluvium also occur along the Kshipra and Khar rivers and the Katkiya nalla
Industries	Food product, Tobacco product, Cotton textile, Wool milk, synthetic powder, Jute product, Housary garments, Wood products, Paper and paper product, Leather and leather product, Rubber and Plastic products, Chemical and chemical product, Metal product, Basic metal industries, Machinery parts, Electric machinery product, Repairing and servicing, Steel furniture, Printing, Paints & Varnish, Pulses mills, Cold storage and Fertilizers, Electronics & Computer parts, Readymade garments, etc. The total number of registered units (small scale and cottage) in the city is 10247 (upto March 2002).
Air quality stations	3 (2 residential, 1 industrial)
Air quality trend	Analysis of nine year air quality data with respect to PM10 shows a decreasing trend till 2007 and increasing thereafter till 2009. NO <sub>2</sub> and SO <sub>2</sub> showed a stable trend. (Figure 7.34).



### 6.3.35 JABALPUR

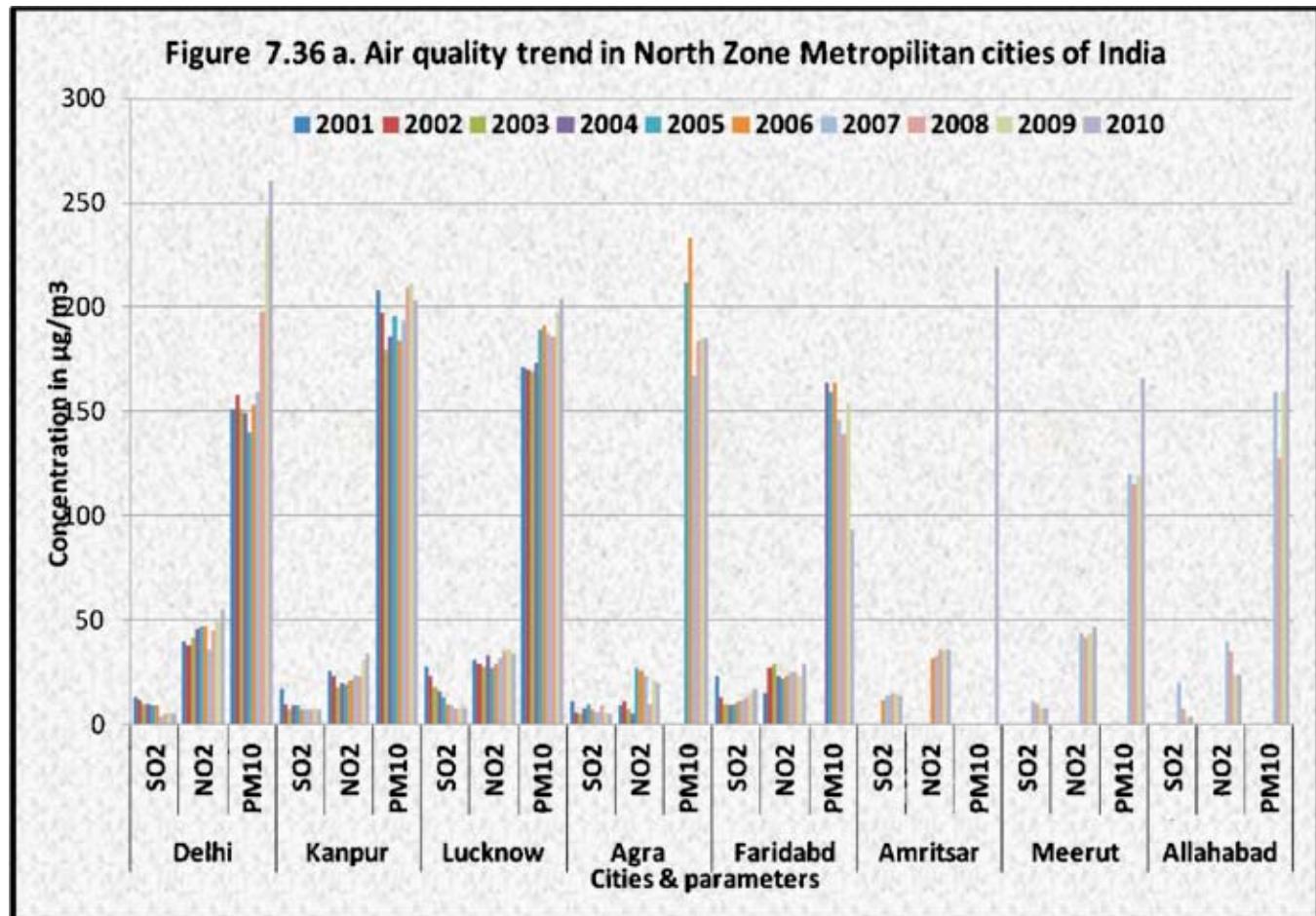
State	Madhya Pradesh
Location	23°6' N and 79°35'24"E, average elevation of 411 metres (1348 feet).
Area	131 km <sup>2</sup>
Population	11,17,200
Climate	Humid subtropical climate. Summers start in late March and last up to June. May is the hottest month followed by the monsoon season, which lasts until early October. Winters start in early November and last until early March. Temperature: average minimum temperature of 18.3 °C and an average maximum of 32.1 °C. Rainfall annual rainfall of 1130 mm with June to September being the principal rainy period
Geography	rocks of Archaen era, Bijawars, Vindhyan, Gondwanas, Lametas and Deccan traps. Schists, gneiss and granite are prevalent in the Archaeans
Industries	Steel fabrication factories, food products, polythene, RCC hume pipes, plastic base factories, sodium silicate, telecom, air products, etc. The total number of registered small scale and cottage units in the city is 320.
Air quality stations	1 (1 residential)
Air quality trend	Analysis of nine year air quality data with respect to PM10 shows a fluctuating trend where the pollutant increases during 2005 and 2008 and slightly decreases during 2009 but remaining above NAAQS. NO <sub>2</sub> and SO <sub>2</sub> showed a more or less stable trend. (Figure 7.35).

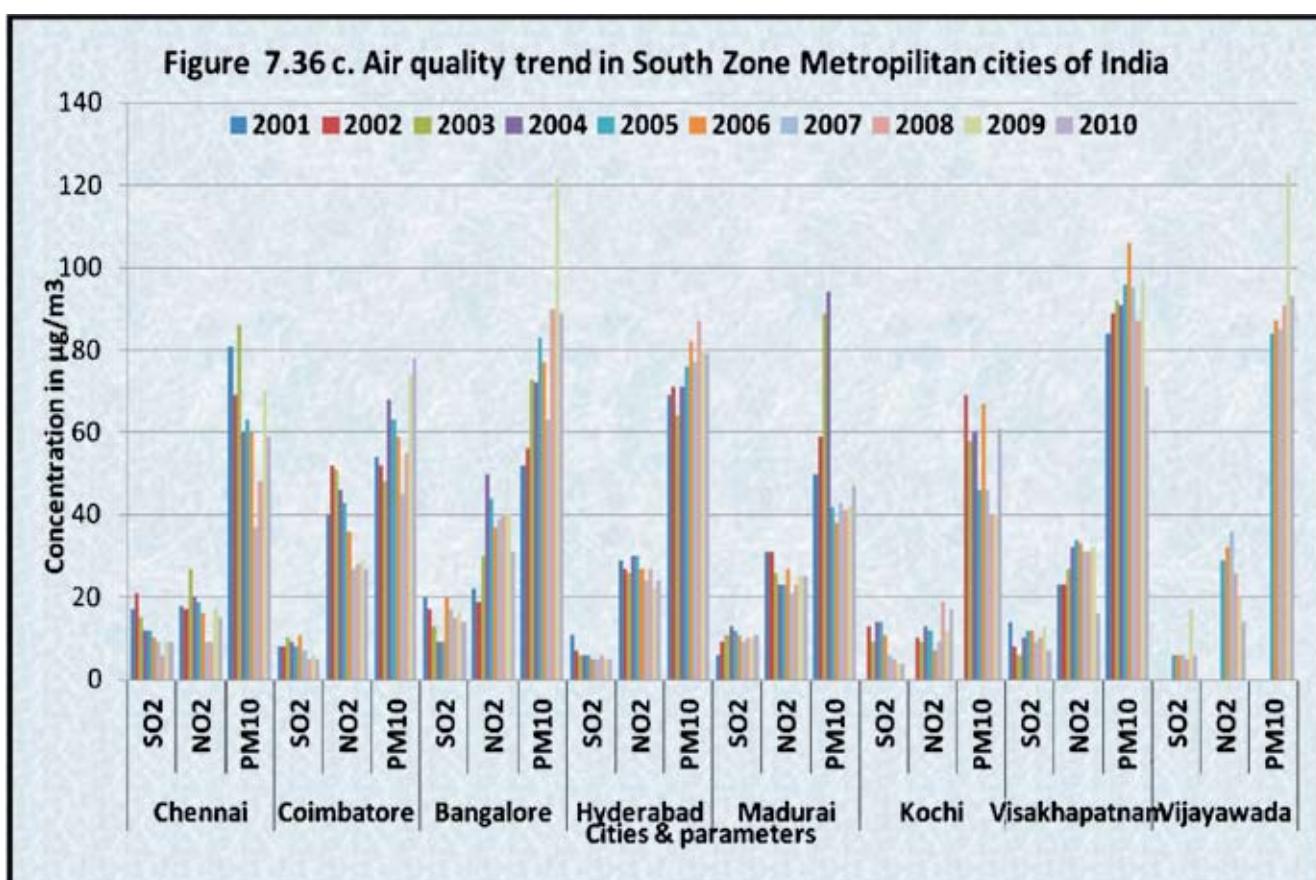
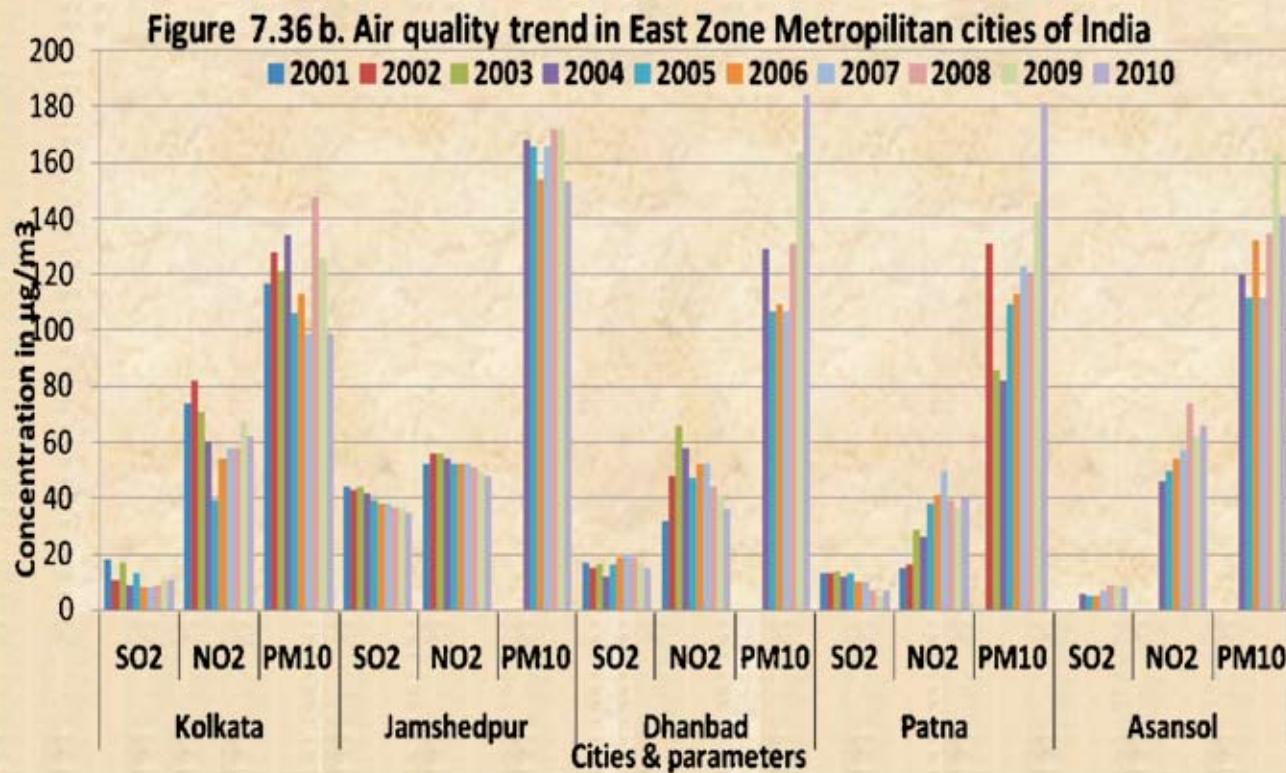


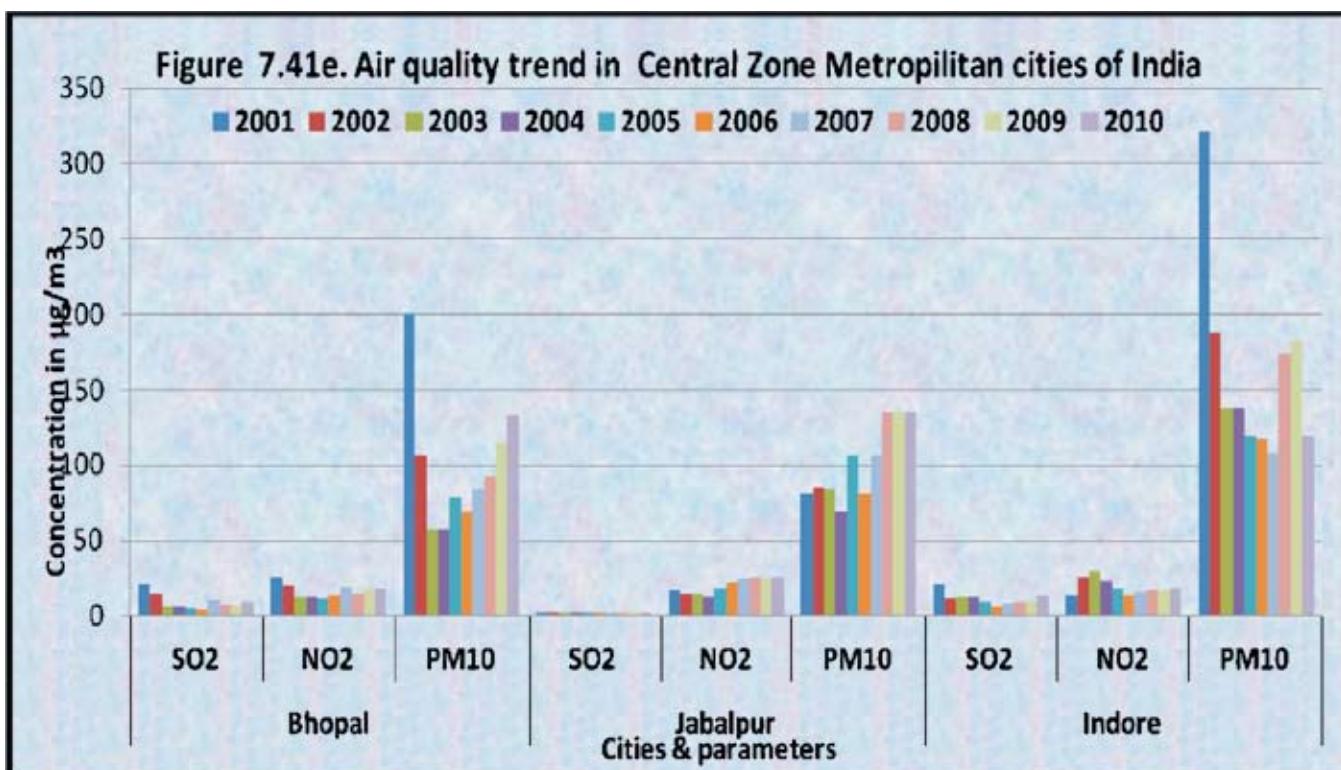
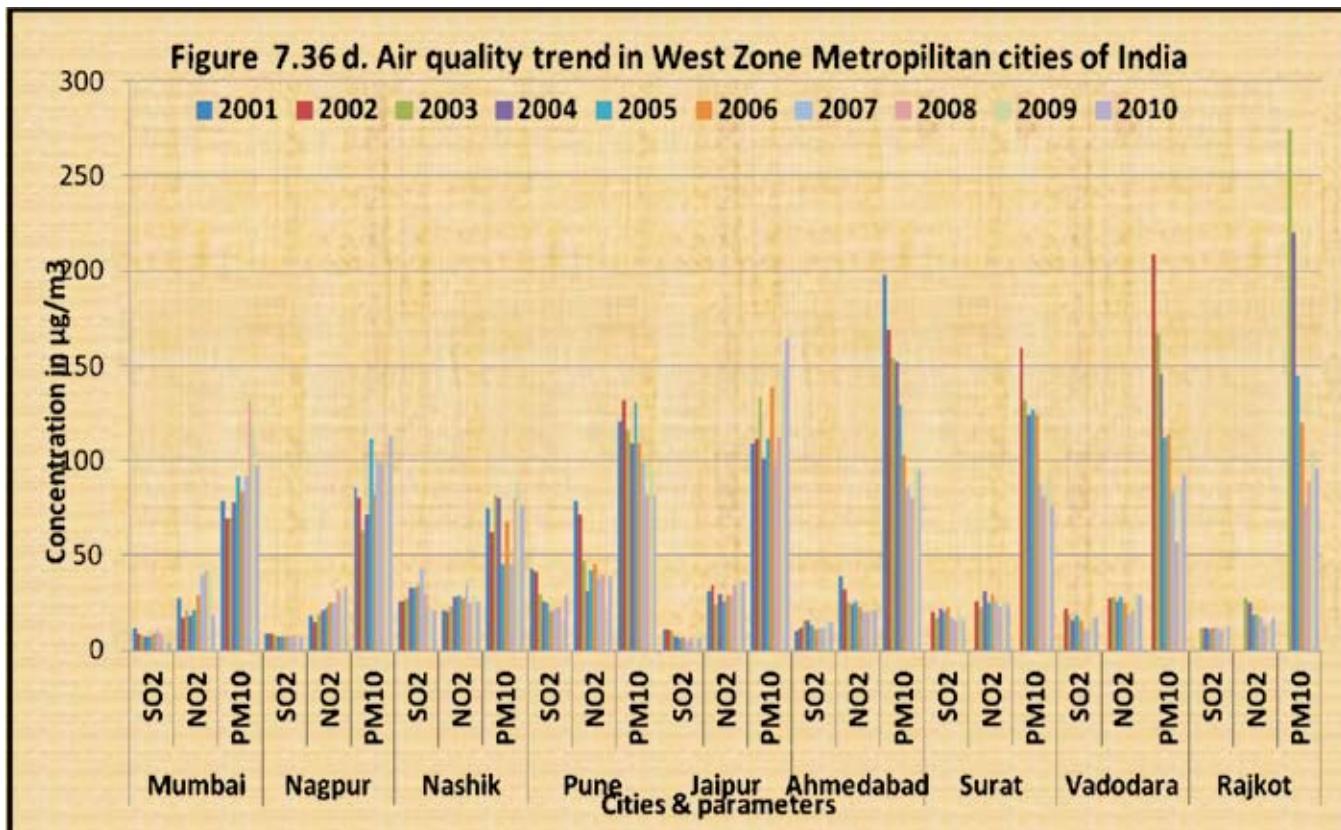
#### 7.4 Air quality trend in different zones of India with respect to metropolitan cities

The trend in air quality in different zones viz. north, east, south, west and central zones are depicted in Figure 6.41 a, b, c, d and e respectively

**Figure 7.36 Air quality trend in the different zones (north, east, south, west, central) in India**







In addition to criteria pollution like  $\text{SO}_2$ ,  $\text{NO}_2$  and  $\text{PM}_{10}$  Central Pollution Control board carried out four additional parameters such as Ammonia ( $\text{NH}_3$ ), Carbon Monoxide (CO), Ozone ( $\text{O}_3$ ) and Particulate matter with size less than or equal to 2.5 micrometer ( $\text{PM}_{2.5}$ ).  $\text{NH}_3$  has been measured in six metro cities viz Delhi, Mumbai, Chennai, Kolkata, Nagpur and Hyderabad with the help of National Environmental Engineering Research Institute (NEERI) under NAMP.

### 8.1 Ammonia Levels

Annual average concentration of ammonia has been compared with the NAAQS. The air quality has been categorized into four broad categories based on an Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard). The four categories are low, moderate, high and critical as explained in earlier chapters. Low levels were observed in Nagpur, Kolkata and residential areas of Mumbai. Moderate levels were observed in Hyderabad, Delhi, Chennai and industrial areas of Mumbai. There was no exceedence of air quality standards (annual average and 24 hourly averages) at all the monitored locations except Parel in Mumbai. The air quality is given in Table 8.1. Annual average concentration of ammonia at 18 monitoring stations in 6 cities are given in Table 8.2

**Table 8.1 : Ambient Air Quality wrt Ammonia in India during 2010**

Pollution level	Annual Mean Concentration Range ( $\mu\text{g}/\text{m}^3$ )	
<b>Low (L)</b>	0-50	
<b>Moderate (M)</b>	51-100	
<b>High (H)</b>	101-150	
<b>Critical (C)</b>	$> 150$	
<b>STATE, UT / CITY</b>	<b>Ammonia</b>	
<b>AREA CLASS</b>	<b>Industrial Areas</b>	<b>Residential Areas</b>
<b>Andhra Pradesh</b>		
Hyderabad	M	M
<b>Delhi</b>		
Delhi	M	M
<b>Maharashtra</b>		
Mumbai	M	L
Nagpur	L	L
<b>Tamil Nadu</b>		
Chennai	M	M
<b>West Bengal</b>		
Kolkata	L	L

**Table 8.2: Summary of Ammonia Levels (Annual Average Concentration in  $\mu\text{g}/\text{m}^3$ ) during 2010.**

S.No.	State / UT	City	Location	Air Quality								
				% exceedence ( 24 hrly avg.)		Std. Dev.		90 percentile		50 percentile		10 percentile
				NH <sub>3</sub> Annual Average ( $\mu\text{g}/\text{m}^3$ )		Max		Min		No. of mon. days (n)		Type of Area
1	Andhra Pradesh	Hyderabad	Nacharam	-	96	28	103	51	35	48	66	15
			Tarnaka	R	96	22	119	56	38	55	76	17
2	Delhi	Delhi	ABIDS Circle	R	96	27	124	67	45	62	97	20
			Mayapuri Ind. Area	I	96	32	136	84	59	87	108	20
3	Maharashtra	Mumbai	Sarojini Nagar	R	96	30	120	77	52	75	106	20
			Town Hall	R	96	44	137	89	66	84	121	22
4	Tamil Nadu	Chennai	Parel	I	98	5	459	54	6	38	118	62
			Worli	R	103	5	317	47	7	33	93	53
5	West Bengal	Kolkata	Kalbadevi	R	84	5	285	48	7	35	102	45
			Hingna Road	I	82	5	125	28	8	23	55	23
	Nagpur		Maskasath	R	99	5	107	39	13	32	75	25
			NEERI Lab., Nehru Marg	R	99	5	204	27	8	22	51	24
			Thiruvottiyur Municipal Office	I	95	8	175	70	15	59	142	48
			Madras Medical College	R	94	6	166	65	18	45	138	46
			NEERI CSIR Campus	R	95	7	172	59	14	44	130	45
			Cossipore	I	96	5	18	8	5	7	13	3
			Lal Bazaar	R	96	5	26	8	5	8	13	4
			Kasba	R	96	5	17	7	5	6	12	3

Note:- R – Residential and other areas, I – Industrial area, Std dev. – Standard deviation, n – number of days monitored for 16 and more hours a day L- Low, M- Moderate, H – High and C – Critical levels of pollution based on exceedence factor (calculated for  $n \geq 50$  days), % exceedence (24 hrly avg.) – Percentage violation wrt NAAQS ( 24 hourly average).

## 8.2 Carbon Monoxide

### a) CO levels at BSZ Marg ( ITO)

Carbon monoxide is monitored at Bahadur Shah Zafar (BSZ) Marg, New Delhi using Non-Dispersive Infrared Spectrometry (NDIR) method. Monthly average and annual average concentration of CO is given in Table 8.3. The annual average concentration of CO was  $2072 \mu\text{g}/\text{m}^3$  during 2010 and monthly average concentration varied from  $1246 \mu\text{g}/\text{m}^3$  to  $3624 \mu\text{g}/\text{m}^3$ . High levels of CO might be attributed to increase in vehicular population especially passenger cars in Delhi.

**Table 8.3: Concentration of Carbon Monoxide (CO) at BSZ Marg, New Delhi during 2010**

Months of 2010	CO Concentration ( $\mu\text{g}/\text{m}^3$ )
January	3624
February	3201
March	2660
April	2189
May	1740
June	1246
July	1421
August	1396
September	1253
October	1913
November	2784
December	1360
Annual Average	2072

NA – Data not adequate

### b) CO levels at Siri Fort

Carbon monoxide is monitored at Siri Fort, New Delhi using Non-Dispersive Infrared Spectrometry (NDIR) method. Monthly average and annual average concentration of CO is given in Table 8.4. The annual average concentration of CO was  $2727 \mu\text{g}/\text{m}^3$  during 2010 and the monthly average concentration varied from  $1184 \mu\text{g}/\text{m}^3$  to  $4238 \mu\text{g}/\text{m}^3$ . High levels of CO might be attributed to increase in vehicular population especially passenger cars in Delhi.

**Table 8.4: Concentration of Carbon Monoxide (CO) at Siri Fort, New Delhi during 2010**

Months of 2010	CO Concentration ( $\mu\text{g}/\text{m}^3$ )
January	2357
February	1827
March	1518
April	1184
May	NA
June	NA
July	NA
August	NA
September	NA
October	2965
November	4238
December	3384
Average	2727

NA – Data not available

### c) CO levels at Delhi College of Engineering (DCE), Bhawana

Carbon monoxide is monitored at Delhi College of Engineering (DCE), Bhawana, Delhi using Non-Dispersive Infrared Spectrometry (NDIR) method. Monthly average and annual average concentration of CO is given in Table 8.5. The annual average concentration of CO was  $1014 \mu\text{g}/\text{m}^3$  during 2010. The monthly average concentration varied from  $426 \mu\text{g}/\text{m}^3$  to  $1930 \mu\text{g}/\text{m}^3$ . High levels of CO might be attributed to increase in vehicular population especially passenger cars in Delhi.

**Table 8.5: Concentration of Carbon Monoxide (CO) at DCE, Bhawana, Delhi during 2010**

Months of 2010	CO Concentration ( $\mu\text{g}/\text{m}^3$ )
January	1023
February	1166
March	1313
April	789
May	853
June	582
July	426
August	630
September	763
October	1132
November	1930
December	1391
Average	1014

NA – Data not available/not adequate

### 8.3 Ozone

#### a) Ozone level at BSZ Marg ( ITO)

Ozone was measured at BSZ Marg (ITO) using continuous analysers. Monthly average and annual average concentration of Ozone are given in Table 8.6. The annual average concentration of Ozone was  $33 \mu\text{g}/\text{m}^3$  during 2010. The monthly average concentration of ozone varied from  $15 \mu\text{g}/\text{m}^3$  to  $54 \mu\text{g}/\text{m}^3$ .

**Table 8.6: Concentration of Ozone at BSZ Marg (ITO), New Delhi during 2010**

Months of 2010	Ozone Concentration ( $\mu\text{g}/\text{m}^3$ )
January	15
February	25
March	36
April	30
May	31
June	33
July	41
August	54
September	36
October	42
November	26
December	24
Average	33

NA – Data not available/not adequate

Higher ozone concentrations are observed, in general, in Summer months as it is formed by photochemical reactions of  $\text{NO}_x$  and VOCs. Ozone concentrations tend to peak in early to mid afternoon in areas where there is strong photochemical activity.

### b) Ozone levels at Siri Fort

Ozone was measured at Siri Fort using continuous analysers. Monthly average and annual average concentration of Ozone are given in Table 8.7. The annual average concentration of Ozone was  $34 \mu\text{g}/\text{m}^3$  during 2010. The monthly average concentration of ozone varied from  $24 \mu\text{g}/\text{m}^3$  to  $51 \mu\text{g}/\text{m}^3$ . The values indicate that ozone levels are within NAAQS.

**Table 8.7: Concentration of Ozone at Siri Fort, New Delhi during 2010**

Months of 2010	Ozone Concentration ( $\mu\text{g}/\text{m}^3$ )
January	51
February	37
March	31
April	26
May	NA
June	NA
July	NA
August	NA
September	NA
October	30
November	28
December	24
Average	34

NA – Data not available/not adequate

Higher ozone concentrations are observed, in general, in Summer months as it is formed by photochemical reactions of  $\text{NO}_x$  and VOCs. Ozone concentrations tend to peak in early to mid afternoon in areas where there is strong photochemical activity. The values indicate that ozone levels are within NAAQS.

### c) Ozone levels Delhi College of Engineering (DCE), Bhawana

Ozone was measured at Delhi College of Engineering (DCE) using continuous analysers. Monthly average and annual average concentration of Ozone are given in Table 8.8. The annual average concentration of Ozone was  $72 \mu\text{g}/\text{m}^3$  during 2010. The monthly average concentration of ozone varied from  $36 \mu\text{g}/\text{m}^3$  to  $141 \mu\text{g}/\text{m}^3$ .

**Table 8.8: Concentration of Ozone at DCE, Bhawana, Delhi during 2010**

Months of 2010	Ozone Concentration ( $\mu\text{g}/\text{m}^3$ )
January	36
February	70
March	88
April	141
May	91
June	47
July	46
August	43
September	63
October	126
November	60
December	57
	72

NA – Data not available/not adequate

Higher ozone concentrations are observed, in general, in Summer months as it is formed by photochemical reactions of  $\text{NO}_x$  and VOCs. Ozone concentrations tend to peak in early to mid afternoon in areas where there is strong photochemical activity. The values indicate that ozone levels are within NAAQS.

#### 8.4 Particulate matter with size less than or equal to $2.5 \mu\text{m}$ ( $\text{PM}_{2.5}$ )

##### a) Particulate matter with size less than or equal to $2.5 \mu\text{m}$ ( $\text{PM}_{2.5}$ ) at Pritampura, New Delhi

Particulate matter with size less than or equal to  $2.5$  micrometer ( $\text{PM}_{2.5}$ ) was measured at Pritampura, New Delhi using continuous analysers. Monthly average and annual average concentration of  $\text{PM}_{2.5}$  are given in Table 8.9. The annual average concentration of  $\text{PM}_{2.5}$  was  $72 \mu\text{g}/\text{m}^3$  during 2010. The monthly average concentration of  $\text{PM}_{2.5}$  varied from  $30 \mu\text{g}/\text{m}^3$  to  $143 \mu\text{g}/\text{m}^3$ . Higher  $\text{PM}_{2.5}$  levels were observed in winter months as mixing height is lower in winter months resulting in less volume of troposphere for mixing and hence higher concentrations. Lower concentrations were observed in monsoon months as particulate matters are washed out due to wet deposition.

**Table 8.9: Concentration of  $\text{PM}_{2.5}$  at Pritampura, New Delhi during 2010**

Months of 2010	$\text{PM}_{2.5}$ Concentration ( $\mu\text{g}/\text{m}^3$ )
January	143
February	30
March	61
April	68
May	57
June	49
July	40
August	58
September	36
October	112
November	117
December	132
Average	72

NA – Data not available/not adequate

##### c) Particulate matter with size less than or equal to $2.5 \mu\text{m}$ ( $\text{PM}_{2.5}$ ) at Sirifort, New Delhi

Particulate matter with size less than or equal to  $2.5$  micrometer ( $\text{PM}_{2.5}$ ) was measured at Sirifort, New Delhi using continuous analysers. Monthly average and annual average concentration of  $\text{PM}_{2.5}$  are given in Table 8.10. The annual average concentration of  $\text{PM}_{2.5}$  was  $103 \mu\text{g}/\text{m}^3$  during 2010. The monthly average concentration of  $\text{PM}_{2.5}$  varied from  $43 \mu\text{g}/\text{m}^3$  to  $235 \mu\text{g}/\text{m}^3$ . Higher  $\text{PM}_{2.5}$  levels were observed in winter months as mixing height is lower in winter months resulting in less volume of troposphere for mixing and hence higher concentrations. Lower concentrations were observed in monsoon months as particulate matters are washed out due to wet deposition.

**Table 8.10: Concentration of  $\text{PM}_{2.5}$  at Sirifort, New Delhi during 2010**

Months of 2010	$\text{PM}_{2.5}$ Concentration ( $\mu\text{g}/\text{m}^3$ )
January	155
February	182
March	187
April	107
May	235
June	131
July	63
August	43
September	61
October	88
November	77
December	53
Average	103

NA – Data not available/not adequate

**d) Particulate matter with size less than or equal to 2.5  $\mu\text{m}$  ( $\text{PM}_{2.5}$ ) at Janakpuri, New Delhi**

Particulate matter with size less than or equal to 2.5 micrometer ( $\text{PM}_{2.5}$ ) was measured at Janakpuri, New Delhi using continuous analysers. Monthly average and annual average concentration of  $\text{PM}_{2.5}$  are given in Table 8.11. The annual average concentration of  $\text{PM}_{2.5}$  was  $107 \mu\text{g}/\text{m}^3$  during 2010. The monthly average concentration of  $\text{PM}_{2.5}$  varied from  $38 \mu\text{g}/\text{m}^3$  to  $197 \mu\text{g}/\text{m}^3$ . Higher  $\text{PM}_{2.5}$  levels were observed in winter months as mixing height is lower in winter months resulting in less volume of troposphere for mixing and hence higher concentrations. Lower concentrations were observed in monsoon months as particulate matters are washed out due to wet deposition.

**Table 8.11: Concentration of  $\text{PM}_{2.5}$  at Janakpuri, New Delhi during 2010**

Months of 2010	$\text{PM}_{2.5}$ Concentration ( $\mu\text{g}/\text{m}^3$ )
January	197
February	148
March	163
April	38
May	70
June	157
July	41
August	100
September	59
October	100
November	127
December	167
Average	107

NA – Data not available/not adequate

**e) Particulate matter with size less than or equal to 2.5  $\mu\text{m}$  ( $\text{PM}_{2.5}$ ) at Nizamuddin, New Delhi**

Particulate matter with size less than or equal to 2.5 micrometer ( $\text{PM}_{2.5}$ ) was measured at Nizamuddin, New Delhi using continuous analysers. Monthly average and annual average concentration of  $\text{PM}_{2.5}$  are given in Table 8.12. The annual average concentration of  $\text{PM}_{2.5}$  was  $79 \mu\text{g}/\text{m}^3$  during 2010. The monthly average concentration of  $\text{PM}_{2.5}$  varied from  $22 \mu\text{g}/\text{m}^3$  to  $261 \mu\text{g}/\text{m}^3$ . Higher  $\text{PM}_{2.5}$  levels were observed in winter months as mixing height is lower in winter months resulting in less volume of troposphere for mixing and hence higher concentrations. Lower concentrations were observed in monsoon months as particulate matters are washed out due to wet deposition.

**Table 8.12: Concentration of  $\text{PM}_{2.5}$  at Nizamuddin, New Delhi during 2010**

Months of 2010	$\text{PM}_{2.5}$ Concentration ( $\mu\text{g}/\text{m}^3$ )
January	261
February	NA
March	NA
April	65
May	59
June	162
July	30
August	22
September	33
October	91
November	80
December	103
Average	79

NA – Data not available/not adequate

### e) Particulate matter with size less than or equal to $2.5 \mu\text{m}$ ( $\text{PM}_{2.5}$ ) at Shahzada Bagh, New Delhi

Particulate matter with size less than or equal to 2.5 micrometer ( $\text{PM}_{2.5}$ ) was measured at Shahzada Bagh, New Delhi using continuous analysers. Monthly average and annual average concentration of  $\text{PM}_{2.5}$  are given in Table 8.13. The annual average concentration of  $\text{PM}_{2.5}$  was  $85 \mu\text{g}/\text{m}^3$  during 2010. The monthly average concentration of  $\text{PM}_{2.5}$  varied from  $43 \mu\text{g}/\text{m}^3$  to  $148 \mu\text{g}/\text{m}^3$ . Higher  $\text{PM}_{2.5}$  levels were observed in winter months as mixing height is lower in winter months resulting in less volume of troposphere for mixing and hence higher concentrations. Lower concentrations were observed in monsoon months as particulate matters are washed out due to wet deposition.

**Table 8.13: Concentration of  $\text{PM}_{2.5}$  at Shahzada Bagh, New Delhi during 2010**

Months of 2010	$\text{PM}_{2.5}$ Concentration ( $\mu\text{g}/\text{m}^3$ )
January	148
February	78
March	106
April	64
May	61
June	79
July	43
August	67
September	50
October	102
November	130
December	94
Average	85

NA – Data not available/not adequate

### f) Particulate matter with size less than or equal to $2.5 \mu\text{m}$ ( $\text{PM}_{2.5}$ ) at Shahdara, Delhi

Particulate matter with size less than or equal to 2.5 micrometer ( $\text{PM}_{2.5}$ ) was measured at Shahdara, Delhi using continuous analysers. Monthly average and annual average concentration of  $\text{PM}_{2.5}$  are given in Table 8.14. The annual average concentration of  $\text{PM}_{2.5}$  was  $85 \mu\text{g}/\text{m}^3$  during 2010. The monthly average concentration of  $\text{PM}_{2.5}$  varied from  $35 \mu\text{g}/\text{m}^3$  to  $171 \mu\text{g}/\text{m}^3$ . Higher  $\text{PM}_{2.5}$  levels were observed in winter months as mixing height is lower in winter months resulting in less volume of troposphere for mixing and hence higher concentrations. Lower concentrations were observed in monsoon months as particulate matters are washed out due to wet deposition.

**Table 8.14: Concentration of  $\text{PM}_{2.5}$  at Shahdara, Delhi during 2010**

Months of 2010	$\text{PM}_{2.5}$ Concentration ( $\mu\text{g}/\text{m}^3$ )
January	171
February	106
March	119
April	68
May	54
June	44
July	44
August	60
September	35
October	100
November	137
December	88
Average	85

NA – Data not available/not adequate

## 8.5 Conclusion

It is observed Ammonia ( $\text{NH}_3$ ) is within NAAQS in six metro cities. With respect to Ozone ( $\text{O}_3$ ) the values at Delhi are within NAAQS, however in case of  $\text{PM}_{2.5}$  and Carbon monoxide (CO) with respect to Delhi the value observed is mostly above the NAAQS. These observations indicate the vehicular pollution is the major cause of exceedence of CO and  $\text{PM}_{2.5}$  in Delhi.

Various measures have been taken to control air pollution from vehicles, industries and other sources. The steps taken to control air pollution from vehicles and industries are as follows:

## 9.1 Measures taken to Reduce Vehicular Pollution

Automobile Pollution Control initiatives gained this year marks enforcement of a variety of control measures ranging from notification of advanced Euro-IV equivalent emission norms and commensurate fuel for new vehicles to stricter exhaust emission limits for in-use vehicles, augmentation of infrastructures for alternative fuels and mass transits and other urban planning and management options. This year marks the continuation of the implementation of the road map as recommended by the Auto Fuel Policy of India. The vehicular pollution control framework in the country has now shifted its focus towards integrated control and management options and has extended its domain to cover all major metro cities and now it is no more restricted only to capital of India. Important measures pertaining to vehicular pollution control initiated during this financial year are as follows:

### Mass Emission Standards

Mass emission standards are the primary technical policy for controlling emissions from vehicles. The Motor Vehicle Act, 1988, and the Central Motor Vehicles Rules (CMVR), 1989, are the principal instruments for regulation of motor vehicular traffic /emissions throughout the country. The implementation of various provisions of this Act rests with the state governments. The Ministry of Road Transport and Highways (MORTH) acts as a nodal agency for the formulation and implementation of various provisions of the Motor Vehicle Act and CMVR.

- Mass Emission Standards (Bharat Stage IV) have been notified for all categories of new vehicles (except two and three wheelers) in 11 mega cities, to be implemented on or after the 1<sup>st</sup> April, 2010.
- Mass Emission Standards (Bharat Stage III) have been notified for two and three wheelers all over the country, to be implemented on or after the 1<sup>st</sup> April, 2010.
- Mass Emission Standards (Bharat (Trem) Stage III) have been notified for every diesel driven agricultural tractors, to be implemented on or after the 1<sup>st</sup> April, 2010 for the category < 37KW and on or after the 1<sup>st</sup> April, 2011 for the category >37 KW.
- Mass Emission Standards (Bharat Stage III) have been notified for two and three wheelers, to be implemented on or after the 1<sup>st</sup> April, 2010.

### Fuel Quality Specifications

- Auto-Fuels commensurate to Euro III (whole country) and Euro IV (for 11 cities) specifications is proposed to be made available in the respective cities from 01.04.2010.
- The Research Octane Number (RON) for premium petrol available in 11 mega cities has been boosted to 95 with lead content being reduced to 0.005 g/l and benzene content of maximum 1%. From 01.04.2010, the content of sulphur in gasoline is proposed to be reduced to 0.005% (50 mg/kg) from existing 0.015% (150 mg/kg). However, all over the country, content of sulphur in gasoline is proposed to be 0.015% (150 mg/kg) from 01.04.2010.
- For diesel the Cetane Number has been enhanced to 51 with Sulphur content proposed to be reduced further to 0.005 % (50 mg/kg) in the 11 mega cities by 01.04.2010. The amount of sulphur in diesel is proposed to be 0.035% (350 mg/kg) all over the country
- Important fuel specification of Diesel and Gasoline as available in metro cities from 01.04.2010 are as follows:

### Important Fuel Specifications of Diesel and Gasoline

Specifications	Requirements
<b>DIESEL</b>	
Cetane Number (CN), min	51
Total Sulphur, max	0.005 % (50 mg/kg)
Distillation , 95% vol. recovery at 0°C, max	360 °C
Polycyclic Aromatic Hydrocarbon ( PAH), max	11 % mass
<b>GASOLINE</b>	
Research Octane number ( RON), min	95
Reid Vapour pressure (RVP), max	60 kpa
Benzene content, max	1% Volume
Lead content (as Pb),max	0.005 g/l
Sulphur, total, max	0.005 % (50 mg/kg)
Aromatics content, max	35 % volume
Oxygen content, max	2.7 % volume

### In-Use Vehicles

- The tourist transport operators shall not engage or use any vehicle for the purpose of journey, the origin and destination of which falls within the National Capital Region (NCR), unless such vehicle conforms to the mass emission standards (Bharat Stage III), notified vide GSR 58(E) dated January 30, 2009.
- MRTC has constituted a task force to introduce auditing system in PUC centers all over the country, to look into various aspects related to procedure, implementation and suggest effective institutional mechanism for the same, in which CPCB is one of the members.

### Alternate Fuels - Initiatives

There has been lot of developments in this front when various organizations including the Planning Commission, Oil Companies, Auto Sectors, CPCB and other research agencies initiated various demonstration and feasibility studies with alternative fuels like LPG and bio-diesel (B20) in the country. Some of the developments are depicted below:

- Bio-fuels mainly Ethanol and Biodiesel (in B20 form) are the prospective options for India. Pilot studies on ethanol and biodiesel have been completed and many are on-going.
- Efficacy of B20 biodiesel from Jatropha feedstock has been established and experiences gained through some pilot studies. Introduction of biodiesel starting with lower blends like B5, B10, etc. is a possibility now.
- In Kolkata all three wheelers have been ordered to switch over to LPG mode from September, 2005 vide notification No. 2421-WT/3M-73/2005 dated May 24, 2005.
- Besides Delhi & Mumbai, the supply of CNG as automotive fuel has been extended to the cities of Ankleshwar, Vadodra & Surat in Gujarat and Kanpur, Bareli, Agra & Lucknow in Uttar Pradesh. The total CNG vehicles in the country touching over 3.54 Lakh, as per the industry estimates.
- Work is on to introduce bio-diesel in the form of B20 as an automotive fuel in India. Several research studies and field trials have been initiated by Organizations like –IITs, IOC, Mercedes, Railways, etc. Already “Jatropha Carcus” has been identified and earmarked to be the prominent source of biodiesel in the country.
- Efforts for developing and popularizing electric vehicles also gained momentum during this year. Already “Reva Motors” have commercialized a small electric/battery car. Many three-wheeler manufacturers are also contemplating electric driven OEM for Indian markets.

## Other Measures

- Various traffic management options have been adopted by many cities. Governments deal with the increasing vehicle population and to ensure smooth traffic flow. Synchronized traffic lightings with timers, bus-only lanes, parking area demarcation, etc. are few steps initiated in many metro cities of India.
- Bus Rapid Transit System (BRTS) aims at segregation of traffic in various lanes according to type of vehicles. Through BRTS it is expected that the hindrance caused to speed of fast moving vehicles by speed of slow moving vehicles will overcome and mass transit vehicles i.e. buses will move in optimal way. In Delhi BRTS has been implemented at some of the stretches during 2008 and it is proposed to expand in other stretches of the city in a phased manner.
- Road-infrastructure development, management and by-passing of inter-state vehicles, parking restrictions, etc. are other measures being adopted in the cities. Cities like Delhi, Mumbai, Kolkata, Pune etc. have constructed many flyovers and multi-lane roads to ease traffic congestion.
- The Delhi metro line has been extended to various stretches of Delhi for catering more people thereby promoting use of mass public transport system. Other cities are also exploring to start metros and other mass transport systems.
- Interstate trucks which are not destined to Delhi are not allowed to ply within the city limits.

### 9.2. Measures Taken for Controlling Air Pollution from Industries

The measures taken for controlling air pollution from industries are as follows:

Emission standards have been notified under the Environment (Protection) Act, 1986 to check pollution.

Industries have been directed to install necessary pollution control equipment in a time bound manner and legal action has been initiated against the defaulting units.

24 critically polluted areas have been identified. Action Plan have been formulated for restoration of environmental quality in these areas.

Environmental guidelines have evolved for siting of industries.

Environmental clearance is made compulsory for 29 categories of development projects involving public hearing/ NGO participation as an important component of Environmental Impact Assessment process.

Environmental audit in the form of environmental statement has been made mandatory for all polluting industries.

Preparation of zoning Atlas for siting of industries based on environmental considerations in various districts of the country has been taken up.

Power plants (coal based) located beyond 1000 kms from the pit-head are required to use low ash content coal (not exceeding 34%) with effect from 1.6.2002. Power plants located in the sensitive areas are also required to use low ash coal irrespective of their distance from the pit head.

### **9.3. Action Plan for the control of air pollution in sixteen cities identified by the Hon'ble Supreme Court of India**

With the objective of controlling these rapidly burgeoning air pollution problems in our country, the Hon'ble Supreme Court of India, in the matter of CWP No. 13029 of 1995, passed the orders on 05.04.2001, regarding formulation and implementation of action plans for control of pollution in selected cities. The Hon'ble Court stressed the need for such initiatives relating to vehicular pollution in Delhi and directed that action plan for pollution control in the cities/ towns, which do not meet the ambient air quality standards, should be prepared.

On August 14, 2003, the Hon'ble Supreme Court passed the following direction: "CPCB's report shows that the Respirable Particulate Matter (in short "RSPM") levels in Ahmedabad, Kanpur, Sholapur, Lucknow, Bangalore, Chennai, Hyderabad, Mumbai and Kolkata are alarming."

"Issue notices to the States of Maharashtra, Andhra Pradesh, Gujarat, Uttar Pradesh, Karnataka and Tamil Nadu. In the Meantime, we direct that the Union of India and the respective States shall draw a plan for lowering the rate of RSPM level in the aforesaid cities. After the plan is drawn, the same would be placed before EPCA. This may be done within a period of two months. We are excluding Mumbai and Kolkata where the respective High Courts are stated to be monitoring the RSPM levels in those cities. EPCA after examining the matter shall submit a report to this Court within a period of four weeks thereafter."

Further Central Pollution Control Board has also identified various non- attainment cities all over the country on the basis of national ambient air quality data under NAMP. Central Pollution has been coordinating with the concerned state governments of the sixteen critically polluted cities identified by the Hon'ble Supreme Court of India as well as non-attainment cities identified by itself for the preparation of action plan for the control of air pollution in all these cities. Further CPCB is also reviewing and monitoring the implementation of the action plans prepared for these critically polluted as well as non- attainment cities. So far State Governments of the all the sixteen critically polluted cities as identified by the Hon'ble Supreme Court of India have submitted their action plan for controlling air Pollution from all the major sources including industrial, vehicular & domestic sources. The major actions those have been proposed for almost all the cities are:

#### **Industrial Pollution**

- Shifting of Industries from non- confirming zones.
- Switching over to clean technologies.
- Using clean fuels.
- Installation of Pollution control Devices.
- Development of green belt, etc.

#### **Vehicular Pollution**

- Implementation of the emission norms as well as fuel quality in accordance with the road map proposed by the Auto Fuel Policy.
- Switching over to clean alternate fuels like CNG, LPG & Bio-fuels.
- Augmentation in Public Transport system
- Better traffic management
- Implementation of fiscal measures, etc

#### **Domestic Pollution**

- Ban on open burning of garbage, biomass, etc.
- Augmentation on supply of LPG as cooking fuel , etc.

Central Pollution Control Board along with EPCA has been regularly reviewing action plan submitted by State Pollution Control Boards, further it is also monitoring the timely implementation of the action plan.

## SUMMARY OF AMBIENT AIR QUALITY DURING 2010

### 1. Summary of air quality scenario in different locations

- Analysis of annual average concentration of ambient air quality reveal that 295 locations exceeded the standard of  $60 \mu\text{g}/\text{m}^3$  (annual) in residential / industrial / rural / other area and 17 locations exceeded the standard of  $60 \mu\text{g}/\text{m}^3$  (annual) in ecologically sensitive areas with respect to  $\text{PM}_{10}$
- With respect to  $\text{NO}_2$ , 67 locations exceeded the standard of  $40 \mu\text{g}/\text{m}^3$  (annual) in residential / industrial / rural / other area and 4 locations exceeded the standard of  $30 \mu\text{g}/\text{m}^3$  (annual) in ecologically sensitive areas

### 2. Summary of air quality scenario in different cities

- Analysis of annual average concentration of ambient air quality in residential / industrial / rural / other area reveals that 130 cities exceeded the standard of  $60 \mu\text{g}/\text{m}^3$  (annual) with respect to  $\text{PM}_{10}$ . Patna, Raipur, Delhi Ahmedabad, Ranchi, Bhopal, Mumbai, Amritsar, Jaipur, Lucknow, and Kolkata are critical.
- With respect to  $\text{NO}_2$ , 19 cities exceeded the standard of  $40 \mu\text{g}/\text{m}^3$
- Cities like Badlapur and Ulhasnagar (Maharashtra), Asansol, Durgapur, Barrackpur, Howrah, Kolkata Raniganj and Sankrail (West Bengal) are critical with respect to both  $\text{NO}_2$  and  $\text{PM}_{10}$

### 3. Summary of air quality scenario in different states

- Analysis of annual average concentration of ambient air reveled Jharkhand had maximum  $\text{SO}_2$ , West Bengal highest  $\text{NO}_2$  and Delhi highest  $\text{PM}_{10}$  concentration (annual average of residential / industrial / rural / other area and ecologically sensitive area)

### 4. Summary of air quality scenario in different metropolitan cities

- Analysis of annual average concentration of ambient air quality in residential / industrial / rural / other and ecologically sensitive area of metropolitan cities revealed that out of 35 cities, 33 cities exceeded the NAAQS of  $60 \mu\text{g}/\text{m}^3$  for  $\text{PM}_{10}$ .
- With respect to  $\text{NO}_2$ , 5 cities exceeded the standard of  $40 \mu\text{g}/\text{m}^3$  (annual).
- No metropolitan city exceeded the standard limit of  $50 \mu\text{g}/\text{m}^3$  (annual) for  $\text{SO}_2$  during 2010

### 5. Percent exceedence of ambient air quality standard

- With respect to residential/industrial/rural area, considering annual average 11% and 82% location for  $\text{NO}_2$  and  $\text{PM}_{10}$  exceeded NAAQS respectively
- Taking 24-hourly average data into consideration, 5%, 15% and 88% location for  $\text{SO}_2$ ,  $\text{NO}_2$  and  $\text{PM}_{10}$  exceed NAAQS respectively for residential / industrial / rural / other area.
- With respect to ecologically sensitive area, considering annual average concentration, 17% and 65% locations for  $\text{NO}_2$  and  $\text{PM}_{10}$  exceeded NAAQS respectively

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**Annexure 1****Air Pollutants, their sources and effects**

Pollutant	Possible Sources	Anthropogenic	Effects	Environment & Property
	Natural	Human / flora / fauna		
<b>Sulphur dioxide (<math>\text{SO}_2</math>)</b> $\text{SO}_2$ is the chemical compound produced by volcanoes and in various industrial processes and are also a precursor to particulates in the atmosphere.	<ul style="list-style-type: none"> <li>Volcanos (67%)</li> </ul>	<ul style="list-style-type: none"> <li>combustion of fossil fuel (coal, heavy fuel oil in thermal power plants, office, factories)</li> <li>paper Industry</li> <li>extravision &amp; distribution of fossil fuels</li> <li>smelting of metals (sulfide ores to produce copper, lead and zinc)</li> <li>Petroleum refining</li> <li>combustion process in diesel, petrol, natural gas driven vehicles</li> </ul>	<ul style="list-style-type: none"> <li>respiratory illness</li> <li>visibility impairment</li> <li>aggravate existing heart and lung diseases</li> </ul>	<ul style="list-style-type: none"> <li>acid rain</li> <li>aesthetic damage</li> </ul>
<b>Oxides of Nitrogen (NOx)</b> Oxides of nitrogen are a generic term for a group of highly reactive gases that contain nitrogen and oxygen in varying amounts. NOx are emitted as nitrogen oxide (NO) which is rapidly oxidized to more toxic nitrogen dioxide (NO <sub>2</sub> ). Nitrogen dioxide (NO <sub>2</sub> ) is a reddish-brown toxic gas with a characteristic sharp, biting odor and is a prominent air pollutant.	<ul style="list-style-type: none"> <li>Lightning</li> <li>Forest fires</li> <li>Bacterial activity of soil</li> </ul>	<ul style="list-style-type: none"> <li>High temperature combustion (internal combustion engines, fossil fuel-fired power stations, industrial)</li> <li>Burning of Bio-mass and Fossil Fuels</li> </ul>	<ul style="list-style-type: none"> <li>irritates the nose and throat</li> <li>increase susceptibility to respiratory infections</li> </ul>	<ul style="list-style-type: none"> <li>Precursor of ozone formed in the troposphere</li> <li>Form atmospheric fine particulate matter burden as a result of oxidation to form nitrate aerosol</li> </ul>
<b>Respirable Suspended Particulate Matter (PM<sub>10</sub>)</b> , size $\leq 10\mu\text{m}$ , coarse fraction PM <sub>10</sub> - PM <sub>2.5</sub> , called thoracic fraction) Particulate matter (PM) is a complex mixture of suspended solid and liquid particle in semi equilibrium with surrounding gases. The major constituents of RSPM are organic and elemental carbon, metals/elements like silicon, magnesium, iron, ions like sulphates, nitrates, ammonium etc. PM10 can settle in the bronchi and lungs and cause health problems		<ul style="list-style-type: none"> <li>Coarse particles are produced by the mechanical break-up of larger solid particles.</li> <li>Wind blown dust such as road dust, fly ash, soot, agricultural processes</li> <li>Road traffic emissions particularly from diesel vehicles</li> <li>Industrial combustion plants some public power generation</li> <li>Commercial and residential combustion</li> <li>Non-combustion processes (e.g., quarrying)</li> <li>Physical processes of crushing, grinding and abrasion of surfaces.</li> <li>Produced particles, such as those found in urban haze</li> <li>Pollen grains, mould spores, and plant and insect parts</li> <li>Non-combustible materials released when burning fossil fuels.</li> </ul>		<ul style="list-style-type: none"> <li>cardio-pulmonary problems</li> <li>asthma, bronchitis, and pneumonia in older people</li> </ul>

Pollutant	Possible Sources	Anthropogenic	Human / flora / fauna	Environment & Property
	Natural			Effects
<b>Particulate Matter 2.5</b> ( $PM_{2.5}$ , size up to $2.5 \mu\text{m}$ , fine fraction size up to $2.5 \mu\text{m}$ , respirable fraction)	<ul style="list-style-type: none"> <li>Fine particles are largely formed from gases.</li> <li>Ultrafine particles are formed by nucleation, which is the initial stage in which gas becomes a particle. These particles can grow up to a size of <math>1 \mu\text{m}</math> either through condensation, when additional gas condensates or coagulation</li> </ul>	<ul style="list-style-type: none"> <li>Vehicular emission</li> <li>Industrial combustion</li> <li>Public power generation</li> <li>Commercial combustion</li> </ul>	<ul style="list-style-type: none"> <li>some plants</li> <li>residential</li> </ul>	<ul style="list-style-type: none"> <li>oxidative stress</li> <li>respiratory symptoms such as irritation of the airways, coughing, or difficulty breathing</li> <li>decreased lung function</li> <li>aggravated asthma</li> <li>chronic bronchitis</li> <li>irregular heartbeat</li> <li>pulmonary disorders</li> <li>premature death in people with heart or lung disease</li> </ul>
<b>Ozone(<math>O_3</math>)</b>	<p>Ozone is a pale blue gas, soluble in water and non-polar solvents with a specific sharp odor somewhat resembling chlorine bleach.</p> <p>Ozone is a secondary pollutant formed in the atmosphere by reaction between oxides of nitrogen and volatile organic compounds (VOCs) in the presence of sunlight. Peak <math>O_3</math> levels occur typically during the warmer times of the year.</p>	<ul style="list-style-type: none"> <li>ozone is present in the atmosphere in the stratosphere, in a region also known as the ozone layer</li> <li>between about 10 km and 50 km above the surface</li> </ul>	<ul style="list-style-type: none"> <li>formed by the reaction of sunlight on air containing hydrocarbons and nitrogen oxides emitted by car engines, industrial operations, chemical solvents to form ozone</li> <li>electronic equipment such as photocopiers</li> </ul>	<ul style="list-style-type: none"> <li>lung function deficits</li> <li>respiratory illness</li> <li>premature death, bronchitis, heart attack, and other cardiopulmonary problems.</li> <li>ground-level ozone and upper troposphere acts as a greenhouse gas, absorbing some of the infrared energy emitted by the earth</li> </ul>
<b>Lead</b>	<p>Lead is a bright silvery soft, dense, ductile, highly malleable, bluish-white metal that has poor electrical conductivity heavy metal and is highly resistant to corrosion.</p>	<ul style="list-style-type: none"> <li>food (lead is absorbed by plants)</li> <li>Waste incineration</li> <li>Metal processing</li> <li>Paint Industry</li> <li>lead solder in food cans, breast milk, drinking water, Cosmetics, ceramic pottery, burning of firewood or kerosene, indigenous remedies, tobacco and tobacco products, contaminated drinking water, toys, industrial effluents, lead acid batteries, ammunition, paints and varnishes, water pipes</li> <li>automobile exhaust,</li> </ul>	<ul style="list-style-type: none"> <li>Pb is rapidly absorbed into the bloodstream and is believed to have adverse effects on the central nervous system, the cardiovascular system, kidneys, and the immune system</li> <li>causes blood disorders like anemia increase in blood pressure.</li> <li>potent neurotoxin that accumulates both in soft tissues and the bones.</li> <li>causes nephropathy, and colic-like abdominal pains.</li> <li>weakness in fingers, wrists, or ankles.</li> <li>Miscarriage and reduction of fertility in males, delayed puberty in girls</li> <li>permanently reduce the cognitive capacity of children</li> </ul>	

Pollutant	Possible Sources	Anthropogenic	Effects
	Natural		Human / flora / fauna Environment & Property
<b>Carbon monoxide (CO)</b> <small>also called carbonous oxide, is a colorless, odorless and tasteless gas which is slightly lighter than air. It is highly toxic to humans and animals in higher quantities. Mainly formed by incomplete combustion of carbon containing fuels.</small>	<ul style="list-style-type: none"> <li>produced during normal metabolism (by the action of <u>oxygenase</u>) and 2 on the <u>heme</u> from <u>hemoglobin</u> b r e a k d o w n and produces <u>carboxyhemoglobin</u> in normal persons) in low quantities and has some normal biological functions (signalling molecule)</li> <li>volcanic activity</li> <li>forest and bushfires</li> </ul>	<ul style="list-style-type: none"> <li>Exhaust of internal combustion engines, especially of vehicles with petrol engines</li> <li>Burning of carbon fuels</li> <li>organic combustion incineration</li> <li>power station processes</li> <li>Iron smelting</li> <li>burning of crop residues</li> </ul>	<ul style="list-style-type: none"> <li>CO enters the bloodstream through lungs and combines with hemoglobin forms carboxyhemoglobin. This condition is known as <u>anoxemia</u>, which inhibits blood's oxygen carrying capacity to organs and tissues.</li> <li>Persons with heart disease are sensitive to CO poisoning and may experience chest pain if they breathe the gas while exercising.</li> <li>adverse effects on the fetus of a pregnant woman</li> <li>Infants, elderly persons, and individuals with respiratory diseases are also particularly sensitive.</li> <li>anti-inflammatories, vasodilators and encouragers of neovascular growth</li> </ul>
<b>Ammonia (NH<sub>3</sub>)</b> <small>A compound of nitrogen and hydrogen, a colourless gas with a characteristic pungent odour. Contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to food and fertilizers, and either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals.</small>	<ul style="list-style-type: none"> <li>putrefaction of nitrogenous animal and vegetable matter</li> <li>Industrial sites that store ammonia or use it as a refrigerant can release high levels if the chemical leaks or is spilled</li> <li>Ammonia and ammonium salts are also found in small quantities in rainwater, fertile soil and in seawater</li> <li>during volcanic eruption</li> <li>The kidneys secrete NH<sub>3</sub> to neutralize excess acid</li> </ul>	<ul style="list-style-type: none"> <li>Farms</li> <li>Fertilizers Industry</li> <li>Industrial sites that store ammonia or use it as a refrigerant can release high levels if the chemical leaks or is spilled</li> </ul>	<ul style="list-style-type: none"> <li>irritating to skin, eyes, throat, and lungs and cause coughing</li> <li>burns</li> <li>Lung damage and death may occur after exposure to very high concentrations of ammonia</li> </ul>
<b>Benzene (C<sub>6</sub>H<sub>6</sub>)</b> <small>Benzene is a colorless, sweet smelling liquid. Benzene is generated whenever carbon-rich materials undergo incomplete combustion. Benzene is generated whenever carbon-rich materials undergo incomplete combustion.</small>	<ul style="list-style-type: none"> <li>volcanoes</li> <li>forest fires</li> </ul>	<ul style="list-style-type: none"> <li>Combustion of fuel (automotive fuel, wood and stationary fossil fuel, other aromatics)</li> <li>evaporation (fuel storage containers, during refueling)</li> <li>Industrial emission</li> <li>Coke oven</li> <li>Perchloroethylene is emitted from some dry cleaning facilities</li> <li>tobacco smoke, wood smoke</li> <li>glues, paints, furniture wax, and detergents</li> </ul>	<ul style="list-style-type: none"> <li>Hematotoxic, neurotoxic, leukemogenic, carcinogenic effects</li> <li>Chronic exposure to benzene may cause chromosomal damage, immune suppression, aplastic anemia, myelodysplastic syndrome, leukemia, non-Hodgkin's lymphoma, and cancer of the lung and nasopharynx</li> <li>Effect the Reproductive system, developing fetus and fertility in men, low birth weights, delayed bone formation, and bone marrow damage</li> </ul>

Pollutant	Possible Sources	Anthropogenic	Effects
	Natural	Human / flora / fauna	Environment & Property
<b>Polyaromatic hydrocarbons (BaP) (particulate phase only)</b> is a five-ring polycyclic aromatic hydrocarbon whose metabolites are mutagenic and highly carcinogenic	<ul style="list-style-type: none"> <li>coal tar (after a forest fire),</li> <li>eruption of volcanoes</li> <li>automobile exhaust fumes (especially diesel engines), in all smoke resulting from the combustion of organic material</li> <li>charbroiled food, burnt toast, cooked meat products, in burnt foods such as coffee</li> </ul>	<ul style="list-style-type: none"> <li>Incomplete combustion of fuels (processing of coal and crude oil)</li> <li>Combustion of natural gas</li> <li>Road transport</li> <li>Industrial plant</li> <li>Tobacco smoke</li> <li>coal tar</li> </ul>	<ul style="list-style-type: none"> <li>Mutagenic and highly carcinogenic (skin, lung, and bladder cancer in humans and in animals)</li> <li>skin rash or eye irritation</li> <li>Bronchitis</li> </ul>
<b>Arsenic (As)</b> is a solid layered, a ruffled analogue of graphite, metallic gray in color and is a semiconductor. It is a potent poison [ARC] recognizes arsenic and group 1 carcinogen (IARC)	<ul style="list-style-type: none"> <li>volcanic ash,</li> <li>weathering of the arsenic-containing mineral and ores as well as groundwater.</li> <li>food, water, soil and air</li> </ul>	<ul style="list-style-type: none"> <li>Smelting of metals,</li> <li>Combustion of fuels (especially of low-grade brown coal)</li> <li>Use of pesticides.</li> <li>wood preservation, glass production, nonferrous metal alloys, electronic semiconductor manufacturing.</li> <li>coke oven emissions associated with the smelter industry</li> </ul>	<ul style="list-style-type: none"> <li>epigenetic changes</li> <li>multi-system organ failure</li> <li>As poisoning</li> </ul>
<b>Nickel (Ni)</b> a silvery-white lustrous corrosion-resistant metal with a slight golden tinge	<ul style="list-style-type: none"> <li><u>urease</u> (an enzyme which assists in the hydrolysis of urea)</li> </ul>	<ul style="list-style-type: none"> <li>Combustion of fossil fuels</li> <li>Nickel plating</li> <li>Metallurgical processes</li> </ul>	<ul style="list-style-type: none"> <li>Nickel sulfide fume and dust is believed to be carcinogenic</li> <li>allergy, dermatitis. Sensitivity to nickel may also be present in patients with pompholyx.</li> <li>explosive in air</li> </ul>

## Methods of Measurement of twelve notified parameters in Ambient Air

### (NAAQS notified in November 2009)

#### a) Sulphur Dioxide ( $\text{SO}_2$ ) in Ambient Air

Sulphur dioxide content in the ambient air is measured by the modified West and Gaeke method. Sulphur dioxide in ambient air is absorbed in a solution of 0.04M sodium tetrachloromercurate at an average flow rate of 1 liter per minute (LPM), resulting in the formation of dischlorosulphitomercurate complex. The main interference is due to the oxides of nitrogen, ozone and trace metals. Interference from oxides of nitrogen can be prevented by adding sulphamic acid, which acts as a reducing agent and converts some of the oxygenated nitrogen species to nitrogen gas. Interference from ozone can be eliminated by aging the sample prior to analysis. Interference from trace metals can be prevented by adding EDTA (disodium salt) to the unexposed absorbing solution. For analysis, the exposed sample is treated with sulphamic acid, formaldehyde and acid bleached pararosaniline containing hydrochloric acid. Pararosaniline, formaldehyde and bisulfite anion react to form violet red coloured pararosaniline methyl sulphonic acid. The intensity of the colour is measured on a spectrophotometer at 560 nm wavelength. The detection range of the  $\text{SO}_2$  concentration is 4 – 1050  $\mu\text{g}/\text{m}^3$ .

Concentration of sulphur dioxide in the range of 25–1050  $\mu\text{g}/\text{m}^3$  can be measured under the conditions given one can measure concentration below 25  $\mu\text{g}/\text{m}^3$  by sampling larger volumes of air, but only if, the absorber efficiency of the particular system is first determined and found to be satisfactory. Higher concentration can be analyzed by using smaller gas samples of a suitable aliquot of the collected sampler. Beer's law is followed through the working range from 0.03 to 1.0 absorbance unit. This corresponds to 0.8–27  $\mu\text{g}$  of sulfite ion in 25 ml of final solution calculated as sulphur dioxide. The lower limit of detection of sulphur dioxide in 10 ml absorbing reagent is 0.75  $\mu\text{g}$  based on twice the standard deviation, which represent a concentration of 25  $\mu\text{g}/\text{m}^3$  in an air sample of 30 litres.

#### b) Nitrogen dioxide ( $\text{NO}_2$ ) in Ambient Air

In the method the  $\text{NO}_2$  from ambient air is absorbed in a solution of sodium hydroxide and sodium arsenite. Sulphur dioxide is the major interfering compound. The interference of sulphur dioxide is eliminated by converting it to sulphuric acid by addition of hydrogen peroxide. The absorbed nitrogen dioxide is then reacted with sulphanilamide in the presence of phosphoric acid at a pH of less than 2 and then coupling it with N-(1Naphthyl) ethylenediamine dihydrochloride. The absorbance of the highly coloured azo dye is measured on spectrophotometer at a wavelength of 540 nm. The detection range of the  $\text{NO}_2$  concentration is 9 – 750  $\mu\text{g}/\text{m}^3$ . The concentration of nitrite ion ( $\text{NO}_2^-$ ) produced during sampling is determined colorimetrically by reacting the nitrite ion with phosphoric acid, sulphanilamide, and N-(1-naphthyl)-ethylenediamine di-hydrochloride (NEDA) and measuring the absorbance of the highly colored azo-dye at 540 nm.

- a) The nominal range of the method is 9 to 750  $\mu\text{g NO}_2/\text{m}^3$  (0.005 to 0.4 ppm)<sup>3</sup>. The range of the analysis is 0.04 to 2.0  $\mu\text{g NO}_2/\text{ml}$ , following Beer's Law throughout this range (0 to 1.0 absorbance units). Under the specified conditions of 50 ml of absorbing reagent, a sampling rate of 200  $\text{cm}^3/\text{min}$  for 24 hours, and a sampling efficiency of 0.82, the range of the method is, therefore, 9 to 420  $\mu\text{g NO}_2/\text{m}^3$  (0.005 to 0.22 ppm). Nitrogen dioxide concentrations in the range of 420 to 750  $\mu\text{g}/\text{m}^3$  (0.22 to 0.4 ppm) are accurately measured by 1:1 dilution of the collected sample.
- b) Based on results from a collaborative study, the within laboratory standard deviation is 8  $\mu\text{g}/\text{m}^3$  (0.004 ppm) and the between laboratory standard deviation is 11  $\mu\text{g}/\text{m}^3$  (0.006 ppm) over the range of 50 to 300  $\mu\text{g NO}_2/\text{m}^3$  (0.027 to 1.16 ppm)<sup>4</sup>.
- c) Based on results from a collaborative study, the method has an average bias of -3% over the range of 50 to 300  $\mu\text{g NO}_2/\text{m}^3$  (0.027 to 0.16 ppm).

**c) Respirable Suspended Particulate Matter (RSPM/ PM<sub>10</sub>) in Ambient Air**

PM<sub>10</sub> are the particulate matter having aerodynamic diameter less than or equal to 10  $\mu\text{m}$  size is a fraction of the particulate matter suspended in air and it represents the fraction that is considered to enter the respiratory system. Sources of PM<sub>10</sub> include road dust, emission from petrol and diesel exhaust, construction and fireplaces. PM<sub>10</sub> may also be formed from other pollutants (acid rain, NO<sub>x</sub>, SO<sub>x</sub>, organics) and from incomplete combustion of any fuel. Monitoring of RSPM is carried out for 24 hours with 8-hourly sampling. RSPM is measured gravimetrically with GFA/EPM 2000 filter paper using respirable dust sampler. In a gravimetric method, air is drawn at a flow rate which is typically 1.1 m<sup>3</sup>/min through a size-selective inlet wherein the particulate matter is fractionated in two aerodynamic diameter size ranges, 0-10 micro meter called RSPM of PM10 and above 10 micro meter called coarse fraction. The PM10 is collected on a 20.3 X 25.4 cm (8 X 10 in) filter. The mass of these particles is determined by the difference in filter weights prior to and after sampling. The concentration of PM<sub>10</sub> is calculated by dividing the weight gain of the filter by the volume of air sampled.

**d) Suspended Particulate Matter (SPM) in Ambient Air**

(The parameter is eliminated from the revised standard November 2009)

SPM are particulate/aerosol having diameter less than 100  $\mu\text{m}$  that tend to remain suspended in the atmosphere for a long period of time. Sea salt, soil dust, volcanic particles and smoke from forest fires are the natural sources of total suspended particulates. Fossil fuel burning and industrial processes are the anthropogenic sources of suspended particulate matter. Monitoring of SPM is carried out for 24 hours with 8-hourly sampling. SPM is measured gravimetrically with GFA/EPM 2000 filter paper using high volume sampler.

For measurement of SPM, ambient air is drawn into a covered housing of HVS through a 20.3 x 25.4 cm (8 x 10") Whatman GF/A or EPM pre weighed glass fiber filter paper at a flow rate of 1.1 to 1.5 cubic meters per minute. The main housing should be rectangular (29 cm x 36 cm) and must be provided with a gable roof having 45° to the horizontal so that the filter is protected from precipitation and particles less than 100  $\mu\text{m}$  size are only collected on the filter surface. Particles within the size range of 100 to 0.1  $\mu\text{m}$  are ordinarily collected on glass fiber filter. The mass concentration of SPM in the ambient air, expressed in micrograms per cubic meter is calculated by measuring the mass of collected particulate and the volume of air drawn.

**e) Particulate Matter (Particle Size < 2.5) –PM<sub>2.5</sub> in Ambient Air**

The Particulate Matter in ambient air (aerodynamic size <2.5 or in atmosphere, is measured by an electrically powered air sampler draws ambient air at a constant volumetric flow rate of 16.7 LMP (1 m<sup>3</sup>/h) maintained by a mass flow controller coupled to a microprocessor into specially designed inertial particle-size separator (cyclones or impactors) where PM<sub>2.5</sub> is separated and collected on a 47 mm poly-tetrafluoroethylene (PTFE) filter over a specified sampling period. Each filter is weighed before and after sample collection to determine the net mass of PM2.5 collected on filter paper. The mass concentration in the ambient air is computed as the total mass of collected PM<sub>2.5</sub> divided by the actual volume of air sampled, and is expressed in  $\mu\text{g}/\text{m}^3$ .

**f) Ammonia (NH<sub>3</sub>) in Ambient Air**

The Ammonia (NH<sub>3</sub>) content in atmosphere/in ambient air is measured by Indophenol method (Method 401, Air Sampling and Analysis, 3rd Edition). Ammonia in the atmosphere/in ambient air is collected by bubbling a measured volume of air through a dilute solution of sulphuric acid to form ammonium sulphate. In a procedure, place 10 ml of absorbing solution in an impinger and sample for one hour at the flow rate of 1 to 2 L/min. After sampling measure the volume of sample and transfer to a sample storage bottle. Finally this can be further transfer to the sample bottle to a 25 ml glass stopper graduated cylinder. Maintain all the solutions and sample at 25° C. Add 2 ml buffer. Add 5 ml of working phenol solution, mix, and fill to about 22 ml. Add 2.5 ml of working hypochlorite solution and rapidly mix. Dilute to 25 ml, mix and store in the dark for 30 minutes to develop colour. The ammonium sulphate

formed in the sample is analyzed calorimetrically by reaction with phenol and alkaline sodium hypochlorite to produce indophenol. The reaction is accelerated by the addition of sodium nitroprusside as catalyst. Measure the absorbance of the solution at 630 nm on a spectrophotometer using 1 cm cells. Prepare a reagent blank and field blank and measure the absorbance as done in the analysis of samples.

### **g) Toxic or Heavy Metals –Arsenic, Lead and Nickel (As, Pb & Ni) in Ambient Air**

The monitoring of Arsenic, Lead and Nickel contents in aerosol of ambient air/atmosphere is measured in particulate matter ( $PM_{10}$  fraction of the particulate matter) having aerodynamic diameter less than or equal to  $10\text{ }\mu\text{m}$  and it is fraction of the particulate matter suspended in air and it represents the fraction that is considered to enter the respiratory system. Sources of  $PM_{10}$  include road dust, emission from petrol and diesel exhaust, construction and fireplaces.  $PM_{10}$  may also be formed from other pollutants (acid rain,  $NO_x$ ,  $SO_x$ , organics) and from incomplete combustion of any fuel. Monitoring of RSPM/PM10 is carried out for 24 hours with 8-hourly sampling. RSPM is measured gravimetrically with EPM 2000 filter paper using respirable dust sampler.

The PM10 is collected on a  $20.3 \times 25.4\text{ cm}$  ( $8 \times 10\text{ in}$ ) filter. The mass of these particles is determined by the difference in filter weights prior to and after sampling. The concentration of  $PM_{10}$  is calculated by dividing the weight gain of the filter by the volume of air sampled. After sampling filters are kept in the envelope marked with necessary identification information and kept in the cool place /refrigerator in the lab ( $20-25\text{ }^{\circ}\text{C}$ ). After collecting samples, transport the filters to the laboratory, taking care to minimize contamination and loss of the sample. The filters should be transported or shipped in a shipping envelope. Store these envelopes at approximately  $30\text{ }^{\circ}\text{C}$  until taken out for analysis. The maximum sample holding times is usually 180 days. Analyze the samples within 180 days. The collected sample on glass fiber filters may be extracted by either hot acid procedure or by microwave extraction (Method IO-3.1). Extracted samples are used for the analysis using flame AAS procedure or furnace AAS procedure (Method IO-3.2). Arsenic is analyzed by Flame–VGA. For Lead (Pb) and Nickel (Ni), the wavelength required for analysis is 217nm and 232nm respectively. Where as in case of Arsenic (As), the VGA should attach with Flame and the wavelength required for analysis is 193.7nm.

As a general rule, samples that can be analyzed by flame or furnace may be more conveniently run with flame since flame atomic absorption is faster, simpler and has fewer interference problems. Tube life depends on sample matrix and atomization temperature. A conservative estimate of tube life is about 50 firings. Read the metal value in  $\mu\text{g/L}$  from the calibration curve or directly from the read-out of the instrument.

### **h) Benzo(a)Pyrene [B(a)p] in Ambient Air**

The Benzo(a)Preen (Bap) content in atmosphere/in ambient air, is measured by the monitoring of aerosol (Particulate Matter) of ambient air/atmosphere. Benzo (a) Pyrene is one of the most important constituent of PAH compounds and also one of the most potent carcinogens. This can be measured in both particulate phase and vapor phase. In the vapor phase the concentration of B(a)p is significantly less than the particulate phase. Therefore more care to be taken for the measurement of Benzo (a) Pyrene in the particulate phase.

The particulate phase of Benzo(a)pyrene is measured in particulate matter ( $PM_{10}$  fraction of the particulate matter) having aerodynamic diameter less than or equal to  $10\text{ }\mu\text{m}$  size of the particulate matter suspended in air and it represents the fraction that is considered to enter the respiratory system. Sources of  $PM_{10}$  include road dust, emission from petrol and diesel exhaust, construction and fireplaces.  $PM_{10}$  may also be formed from other pollutants (acid rain,  $NO_x$ ,  $SO_x$ , organics) and from incomplete combustion of any fuel. Monitoring of RSPM/PM10 is carried out for 24 hours with 8-hourly sampling. RSPM is measured gravimetrically with EPM 2000 filter paper using respirable dust sampler. The PM10 is collected on a  $20.3 \times 25.4\text{ cm}$  ( $8 \times 10\text{ in}$ ) filter. The mass of these particles is determined by the difference in filter weights prior to and after sampling. The concentration of  $PM_{10}$  is calculated by dividing the weight gain of the filter by the volume of air sampled. Filter papers (half of all thee filters papers collected in a day) are finely cut into strips using the scissor and the same is transferred into 250 ml beaker. Add

~50 ml of Toluene (pesticide /GC/HPLC grade). These samples are extracted with toluene using ultra sonic bath for about 30 minutes & repeated twice (50ml x 2 times) for complete extraction. Alternatively sample can be extracted using soxhlet extraction apparatus for about 8 hrs with Toluene twice. Extracted samples were Filtered using glass funnel with Whatman filter paper no.41 containing 2 gm of Anhydrous Sodium sulphate to get dryness (free from the moisture). After filtration, the filtrate taken in the round bottom flask and kept in the rotary evaporator for concentrating the filtrate up to 2ml volume of final Extract. The final volume of 2ml concentrated sample is passed through a silica gel column chromatography /Solid phase extraction (SPHE) column for cleaning the sample impurities. Add 5 ml of cyclohexane at least 3 times for complete elution from the column. Collect the sample in the 25 ml beaker. The Cleaned up extract/filtrate (approximately 17 ml) is concentrated using rotary evaporator and it is then evaporated to nearly dryness with Nitrogen. After dryness, the sample is re-dissolved in 1ml of toluene and the same is transferred into 4 or 5 ml amber vials for final analysis on Gas Chromatography (GC).

**i) Measurement of Benzene in ambient air by photo ionization detector**

**a) Monitoring of benzene in ambient air by BTEX analyzer:**

It is based on chromatographic separation in the gaseous phase coupled with photo ionization detector (PID) for detection. The ambient air is drawn into the sampling tube containing an adsorbent for aromatics and volatile compounds. The adsorbed compounds are thermally desorbed and separated in the chromatographic column by programmed heating. The compounds are subsequently detected and quantified by PID. The result is displayed on the screen. Nitrogen is used as carrier gas. BTEX analyzers are commercially available from a number of manufacturers. These analyzers must be operated in accordance with the manufacturers' instructions and instrument-specific operating procedures.

**b) Measurement of Benzene in ambient air: manual method**

Manual method for measurement of ambient air benzene is based on adsorption of volatile organic compounds on adsorbing column. These compounds are then thermally desorbed or extracted and subsequently detected/determined by gas chromatography. Follow the operating instruction manual of the VOC sampler for sample collection and that of GC for detection.

**j) Measurement of Ozone in ambient air**

Ozone is a highly reactive, colorless gas. It must be measured at the sampling location, as samples cannot be taken back to a laboratory for analysis. Three measurement methods are prescribed in NAAQS- 2009.

- UV photometric
- Chemiluminescence
- Chemical method

**The UV photometric method**

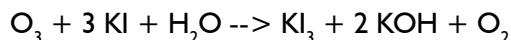
This is based on the attenuation of ultraviolet (UV) radiation by ozone. Ozone exhibits a strong absorption band in the ultraviolet region at 254 nm. This feature is the basis of the photometric measurement method for ozone. Other species present in the atmosphere such as aromatic hydrocarbons also absorb at or near 254 nm, and so represent potential interferences to the method. The commercially-available instruments compensate for this possible interference by comparing the absorbance of the sample with the absorbance of air in which the ozone has been catalytically reduced to molecular oxygen ( $O_2$ ); consequently attenuation of the UV light due to non-ozone species is taken into account. A range of ambient ozone analyzers are commercially available. These UV methods must be operated in accordance with the manufacturers' instructions and instrument-specific operating procedures.

## The Chemiluminescence method

The chemiluminescence method for O<sub>3</sub> is based on direct gas phase reaction of O<sub>3</sub> with olefin to produce electronically excited products, which decay with the emission of light. When ozone reacts with ethylene gas, an olefin, electronically excited formaldehyde is produced. As this excited species returns to the ground state, it gives off light in a band centered at 430 nanometers (nm) in proportion to the amount of ozone present. This chemiluminescence can be measured using a photomultiplier tube, and the concentration of ozone is calculated. Any other measurement method or instrument must be compared against the reference method, and must perform on a par with the reference method to be deemed equivalent. Humidity causes a positive bias in chemiluminescence methods. This can be compensated for the areas of high humidity, the interference has been problematic and the debate continues as to the instrument's complete reliability for such an important purpose. Because the reference method uses a potentially flammable gas as a reactant, and because there is an equivalent method for directly measuring ozone, chemiluminescence-based monitors are seldom used for routine air monitoring.

## Chemical method

This method is based on libration of iodine when micro-amounts of ozone and the oxidants are absorbed in a 1% solution of potassium iodide buffered at pH 6.8 ± 0.2. The iodine is determined spectrophotometrically by measuring the absorption of triiodide ion at 352 nm. The stoichiometry is approximated by the following reaction:



## PROCEDURE

- Assemble a train consisting of a rotameter, U-tube with chromium trioxide paper (optional), midget impinger, needle valve or critical orifice (I) and pump. Connections upstream from the impinger should be ground glass or inert tubing but joined with polyvinyl tubing. Fluorosilicon or fluorocarbon grease should be used sparingly. Pipette exactly 10 ml of the absorbing solution into the midget impinger. Sample at a rate of 0.5 to 3 L/min for up to 30 min. The flow rate and the time of sampling should be adjusted to obtain a sufficiently large concentration of oxidant in the absorbing solution. Approximately 1 µl of ozone can be obtained in the absorbing solution at an atmospheric concentration of 0.01 ppm by sampling for 30 min at 3 L/min. Calculate the total column of the air sample. Also measure the air temperature and pressure. Do not expose the absorbing reagent to direct sunlight.
- Measurement of Color – If there is evaporation of the absorbing solution during sampling; add water to bring the liquid volume to back to 10 ml before making colour measurement
- Within 30 to 60 minutes after sample collection, read the absorbance in a cuvette or tube at 352 nm against a reference cuvette or tube containing water.
- Blank Correction - Measure the absorbance of the unexposed reagent and subtract the value from the absorbance of the sample.

## Calibration and Standardization

- Calibrating solutions are made up to 10 ml to facilitate the calculations:
- Obtain a range of calibration points containing from 1 µl to 10 µl of ozone equivalent per 10.0 ml of solution. Prepare by individually adding 1.0, 2.0, 4.0, 6.0, 8.0 and 10.0 mL of the calibrating iodine solution to 10.0 ml volumetric flasks. Bring each to the calibration mark with absorbing reagent.
- **Read the absorbance of each of the prepared calibration solutions**
- Plot the absorbance of the obtained colors against the concentration of O<sub>3</sub> in µl/10 ml absorbing reagent. Draw a straight line through the origin giving the best fit, or fit by least squares. Do not extrapolate beyond the highest concentration.

## CALCULATIONS

- Standard conditions are taken as 101.3 kPa and 25°C, at which the molar gas volume is 24.47 liters.
- Record the volume of sample collected in liters. Generally the correction of the sample volume to standard conditions is slight and may be omitted. However, for greater accuracy corrections may be calculated by means of the perfect gas laws.
- The total  $\mu\text{l}$  of  $\text{O}_3$ /10 ml of reagent are read from the calibration curve.
- The concentration of  $\text{O}_3$  in the gas phase in  $\mu\text{l/l}$  or ppm is calculated by Total  $\mu\text{l}$  ozone per 10 ml divided by Volume of air sample, L and the concentration of  $\text{O}_3$  in terms of  $\mu\text{g/m}^3$  at 101.3 kPa and 25°C is obtained when desired from the value of  $\mu\text{l/l}$  by dividing  $\text{ppm} \times 48.00 \times 10^3 / 24.47 = 1962 \times \text{ppm}$ .

### K) Measurement of Carbon monoxide in ambient air by non-dispersive infrared (NDIR spectroscopy):

In NDIR based ambient CO analyzers, the spectrometer measures the absorption by CO at 4.7  $\mu\text{m}$ . The detector signal is led to an amplifier control section and the analyzer output measured on a display/meter. NDIR based ambient CO analyzers are commercially available from a number of manufacturers. These analyzers must be operated in accordance with the manufacturers' instructions and instrument-specific operating procedures. Some analyzers use different cells for standard reference gas and sample gas; some others use gas filter correlation to compare the IR absorption spectrum between the measured gas and other gases present in the sample, in a single sample cell. The CO analyzer can be calibrated using certified standard cylinders of CO and following the instructions contained in the instrument's instruction manual.

**MEASUREMENT OF METEOROLOGICAL PARAMETERS:** The measurement of meteorological parameters in ambient air (relative humidity, temperature, wind speed, wind direction).

Ambient temperature and Relative Humidity: Install the temperature and hygrometer sensors in such a way that these are protected from direct sun rays, however, well ventilated hood provided by the manufacturer. A regular cleaning schedule as prescribed by the manufacturer should be maintained.

Wind Speed and wind direction: Wind direction is detected by wind vane. The head of the arrow indicates the direction from which the wind is blowing. The wind direction can either be recorded in degree (0-360) or on 16 point of compass (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW). The wind speed is normally measured by cup anemometer. The unit of measurement may be km/h or m/s. Some manufacturers supply wind vane and cup anemometer for mounting on single rotor/mast other may supply separate rotors/masts.

Selecting the Site of Operation: In general, anemometers are designed to record the wind conditions over a given large areas. In order to obtain comparable values for the determination of surface wind, measurements should be made at a height of 10 meters over open level terrain. Open level terrain is defined as an area where the distance between the anemometer and an obstruction amounts to at least 10 times the height of the obstruction. If, this condition cannot be met, then the anemometer should be set up at such a height where the measured values are, to the greatest extent possible, not influenced by local obstructions (approximately 6-10 meters above the obstruction). The anemometer should be installed in the middle of flat roofs - not at the edge - in order to avoid a possible bias to one direction or the other. Installing the Cup Anemometer – Follow the instructions mentioned in the instruction manual. Align the wind vane to north direction accurately.

Note: For detailed procedure/methods, it can be referred to CPCB Website: [www.cpcb.nic.in/](http://www.cpcb.nic.in/)

1. Volume –I: Guidelines for manual sampling and analyses (along with sample flow chart and data sheets);
2. Volume-II: Guidelines for continuous sampling and real time analyses
3. Volume-III: Reference methods for manual sampling and analyses (compilation)
4. Volume-IV: Reference methods for continuous sampling and real time analyses (compilation)

Note: Guidelines are laboratory and infrastructure specific thus may not be applicable uniformly and need to develop based on infrastructure and expertise.