Government of the People's Republic of Bangladesh

Ministry of Environment and Forests

Monthly Air Quality Monitoring Report
Reporting Month: March, 2015

Clean Air and Sustainable Environment Project
(নির্মলবায়ুএবং টেকসইপরিবেশপ্রকল্প)

April, 2015

Department of Environment

Content

1. Introduction

Air quality management plans based on knowledge of sources, appropriate air quality standards, accurate air quality data, and effective incentives; and enforcement policies is therefore needed to be adopted.

At this backdrop, real-time measurements of ambient level pollutants were made at 8 major cities (Namely, Dhaka, Narayangonj, Gazipur, Chittagong, Rajshahi,Khulna, Barisal and Sylhet) of Bangladesh. The data generated will be used to define the nature and severity of pollution in the cities; identify pollution trends in the country; and develop air models and emission inventories.

The program encompasses operation of the sampling and monitoring network, and quality assurance activities to ensure the quality of the data collected and disseminated by the CASE project.

CASE project monitors the criteria pollutants such as carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, PM10 and PM2.5. Monitoring is performed to demonstrate attainment or non-attainment of national ambient air quality standards to assess the trends of air pollution levels.

The main purpose of this report is to present, analyze and make available of these data to the general public, stakeholders, researchers and policy makers to develop effective air pollution abatement strategies. This report summarizes the air quality data collected at the different CAMS in operation under the Department of Environment (DoE) air quality monitoring network.

The basis for discussion of air quality has been the data collected from the Air Quality monitoring Network stations under DoE. The data have been quality controlled and the air pollution levels have been compared to the Bangladesh Ambient Air Quality Standard as adopted in 2005. Table 1 represents the current and approved air quality standards for Bangladesh.

Table 1: National Ambient Air Quality Standards for Bangladesh

Pollutant	Objective	Average
CO	10 mg/m^3 (9 ppm)	8 hours(a)
	40 mg/m^3 (35 ppm)	1 hour(a)
Pb	0.5 µg/m^3	Annual
NO_x	100 µg/m^3 (0.053 ppm)	Annual
PM10	50 µg/m^3	Annual (b)
	150 µg/m^3	24 hours (c)
PM2.5	15 µg/m^3	Annual
	65 µg/m^3	24 hours
O_3	235 µg/m^3 (0.12 ppm)	1 hour (d)
	157 µg/m^3 (0.08 ppm)	8 hours
SO_2	80 µg/m^3 (0.03 ppm)	Annual
	365 µg/m^3 (0.14 ppm)	24 hours (a)

Notes:
(a) Not to be exceeded more than once per year
(b) The objective is attained when the annual arithmetic mean is less than or equal to 50 ug/m^3
(c) The objective is attained when the expected number of days per calendar year with a 24-hour average of 150 µg/m^3 is equal to or less than 1
(d) The objective is attained when the expected number of days per calendar year with the maximum hourly average of 0.12 ppm is equal to or less than 1 (Source: AQMP, DOE).

2. Monitoring Network

The main objective of the Bangladesh AQM network is to provide reliable information to the authorities and to the public about the air quality in most populous cities of Bangladesh.

As a part of the air quality monitoring strategy, several objectives can be achieved, including:

- Establish source/receptor relationships;
- Identify which are the pollutants of concern and their current status;
- Show how widespread air pollution problems are and indicate the general extent of the public exposure;
- Provide benchmarks against which trends in overall air quality can be compared and devise performance indicators for assessing the impact of an air quality management plan or strategy;
- Provide a data base for evaluation of effects; of urban, land use management, and transportation planning; of development and evaluation of abatement strategies; and of development and validation of atmospheric processes and models.

Another objective in the monitoring and management programme is to provide input data for modeling. These data will serve as a background for performing air quality planning and abatement studies. Model results may also serve as input to other studies such as health related investigations and exposure assessments.

The ambient air quality monitoring network Bangladesh consists of eleven (11) fixed Continuous Air Monitoring Stations (CAMS). The locations of the 11 CAMS are shown in Figure 1. Brief description of the monitoring stations and the list of measured parameters recorded at each station are provided inTable 2.

Table 2: Description of Monitoring Network:

City	ID	Location	Lat/Lon	Monitoring capacity
Dhaka	CAMS-1	SangshadBhaban, Sher-e-Bangla Nagar	23.76N 90.39E	PM10, PM2.5, CO, SO2, NOX, O3, and HC concentrations with meteorological parameters.
	CAMS-2	Firmgate	23.76N 90.39E	PM10, PM2.5, CO, SO2, NOX, O3, and HC with meteorological parameters.
	CAMS-3	Darus-Salam	23.78N 90.36E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Gazipur	CAMS-4	Gazipur	23.99N 90.42E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Narayangonj	CAMS-5	Narayangonj	23.63N 90.51E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Chittagong	CAMS-6	TV station, Khulshi	22.36N 91.80E	PM10, PM2.5, CO, SO2, NOX, O3, and HC with meteorological parameters.
	CAMS-7	Agrabad	22.32N 91.81E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Khulna	CAMS-8	Baira	22.48N 89.53E	PM10, PM2.5, CO, SO2, NOX, O3, and HC with meteorological parameters
Rajshahi	CAMS-9	Sopura	24.38N 88.61E	PM10, PM2.5, CO, SO2, NOX, O3, and HC with meteorological

City	ID	Location	Lat/Lon	Monitoring capacity
				parameters.
Sylhet	CAMS-10	Red Crecent Campus	24.89N 91.87E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Barisal	CAMS-11	DFO office campus	22.71N 90.36E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.

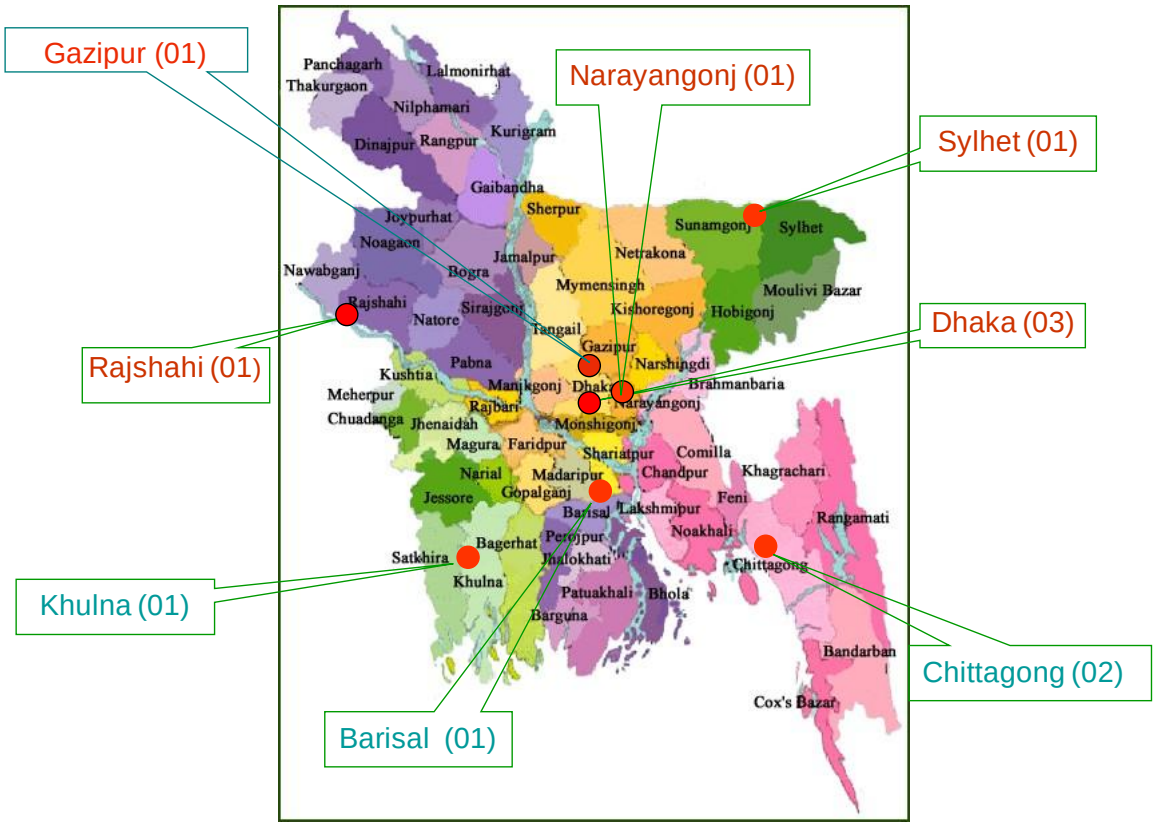


Figure 1: CAMS Location in Bangladesh

Monitoring data from network stations are transferred to a central data centre at the Department of Environment office in Dhaka and simultaneously transferred to Air Quality Management System based on NILU AIRQuis system established under BAPMAN project. The data are stored in AIRQuis database for quality check, control, evaluation, validation, statistical analysis. Quality controlled data are then stored in the final database for further analysis, reporting, presentations and future use.

3. Monthly Air Quality

The data presented in this report are based on monitoring of air quality parameters during March, 2015 at 11 CAMS operated under CASE-DoE monitoring network. Table-3 summarizes the basic statistics of the data along with the data capture rate and the number of days for which specific pollutant exceeded the Bangladesh National Ambient Air Quality Standard (BNAAQS). Since NOx have only annual standard, so for this pollutant daily 24-hours average concentration levels were compared with the annual average. During data quality control some data, which are outliers (beyond 3rd and 97th percentile) and inconsistent data, were flagged as invalid and those were not included in the analysis. Time series plots based on the data generated in the CAMS are also given in Annexes.

In general the data availability (valid data) found to be over 80% except few parameters in some CAMS in operation. During the reporting month several analyzers were not operational due to routine preventive/corrective maintenance. In case of data capture rate for specific pollutant below 75% for a particular averaging time are not reported.

Inspection of the available data shows that there were number of occurrences of non-compliance for PM10& PM2.5 levels at majority of monitoring stations during the month of March, 2015. It is observed that the 24 hr average concentration level of PM2.5 exceeded BNAAQS for 21 days at Darus-Salam, Mirpur & at Barisal CAMS and 23 days at BARC during the month of March 2015. Such non-attainment occurred for 18 days in Sangshad Bhaban & Agrabad, Chittagong, 27 days at Gazipur and also 24 days at Sylhet CAMS. For PM10 non-attainment with respect to BNAAQS occurred for 20 days in Sangsad, 18 days in Darus Salam, 27 days at Gazipur, 20 days at Narayonganj CAMS and 09 days in Agrabad, Chittagong and 15 days at Barisal and 16 days at Sylhet CAMS during the reporting month. The monthly average concentration level of PM2.5 and PM10 measured at different CAMS were found 84-123 µg/m3 and 148-312 µg/m^3 respectively during the month of March 2015. From the time series plot of both PM10 and PM2.5, it is seen there are most of the episodes of high PM concentrations. 24-hours average PM levels in all cities monitored are decreasing compared to previous month because dry seasons in over and wind speed is increasing. Lower wind speed and occurrences of inversion reduces dispersion of particulate matter and thus increases the PM pollution levels in winter season. It is also observed that all the gaseous pollutants except NOx measured at different CAMS did not exceed the BNAAQS during the month of March 2015. NOx concentrations exceed the BNAAQS 13 days in Darussalam, 11 days in Narayonganj CAMS.

In general PM pollution levels in the cities monitored during the reporting month found slightly lower compared to previous month in respect of public health. Usually in the dry seasons the pollution level reached highest peak and gradually decreases during wet season, which is reflected in the data monitored in all CAMS during the month of March 2015. It is observed that average wind speed and precipitation compared to previous month has a increasing tendency, which increases the rate of dispersion of the pollutants and this might be a reason for observed lower PM concentration.

Daily air quality index (AQI) values were calculated based on the available air quality data and summary of the AQI by categories are presented in annex Table 5. Summary data shows majority of the days AQI values were in unhealthy, very unhealthy and few extremely unhealthy categories.

4. Summary and conclusion

Data obtained from CAMS operated under DoE air quality monitoring network during March - 2015 have been analyzed and reported. Data availability was over 70-80% for all the criteria pollutant monitored at different CAMS with few exceptions. Air quality data for some pollutants were not reported because either the analyzer was not functional or the data capture rate was too low. From the analysis of the data following conclusion can be drawn:

- PM_{10} and $PM_{2,5}$ are the most critical pollutants. 24-hour average for both PM10 and PM2.5 concentrations were found non-compliance at majority of the station with the BNAAQS during the month of March -2015. It is observed that the average concentration level of PM2.5 and PM10 measured at different CAMS were found 84-123 µg/m3 and 148-312 µg/m^3 respectively during the month of March 2015.
- The gaseous pollutants except NOx measured at different CAMS did not exceeded limit values of the BNAAQS. NOx concentrations exceed the BNAAQS 13 days in Darussalam, 11 days in Narayonganj CAMS.
- Due to decreasing average wind speed and precipitation during March-2015, dispersion and wash out of pollutants decreases and thus the pollution concentration levels showed higher.

- Monthly summary of calculated AQI values based on data from different CAMS showed that during this month most of day's air quality was either unhealthy or very unhealthy and few extremely unhealthy as well. In all cases most frequent responsible pollutant was PM2.5.

During the reporting month a number of analyzer especially SO2 & NOx did not produced data and they are under maintenance process.

ANNEX

Table 3: Summary Air Quality and Meteorological data measured during March 2015 at different CAMS operated under DoE

Parameter	unit	NAAQS	Summary	CAMS-1 (S-Bhaban)	CAMS-2 (BARC)[a]	CAMS-3 (D-salam)	CAMS-4 (Gazipur)	CAMS-5 (Narayonganj)	CAMS-6 TV-St (Chittagong)[a]	CAMS-7 Agrabad-(Chittagong)	CAMS-8 (Sylhet)	CAMS-9 (Khulna)[a]	CAMS-10 (Rajshahi)[a]	CAMS-11 (Barisal)
SO_2 -24 hr	ppb	140	Average	DNA*	6.14	9.46	DNA*	DNA*	DNA*	12.4	DNA*	DNA*	DNA*	DNA*
			Max	DNA*	11.9	16.4	DNA*	DNA*	DNA*	16.7	DNA*	DNA*	DNA*	DNA*
			Min	DNA*	1.60	5.73	DNA*	DNA*	DNA*	7.47	DNA*	DNA*	DNA*	DNA*
			Excedance(Days)	DNA*	0	0	DNA*	DNA*	DNA*	0	DNA*	DNA*	DNA*	DNA*
			Data capture(%)	DNA*	83	97	DNA*	DNA*	DNA*	95	DNA*	DNA*	DNA*	DNA*
NO_2 -24 hr	ppb	53 (Annual)	Average	DNA*	DNA*	56.3	19.5	43.9	DNA*	5.89	23.9	DNA*	DNA*	DNA*
			Max	DNA*	DNA*	155	52.5	82.6	DNA*	17.7	40.7	DNA*	DNA*	DNA*
			Min	DNA*	DNA*	12.6	5.51	11.00	DNA*	2.62	14.8	DNA*	DNA*	DNA*
			Excedance(Days)	DNA*	DNA*	13	0	11	DNA*	0	0	DNA*	DNA*	DNA*
			Data capture(%)	DNA*	DNA*	94	90	93	DNA*	94	95	DNA*	DNA*	DNA*
CO- 1 hr	ppm	35	Average	DNA*	5.07	3.43	1.91	1.38	0.74	1.58	3.29	DNA*	0.61	1.13
			Max	DNA*	16.4	7.57	3.56	5.87	8.48	9.50	5.85	DNA*	1.24	3.84
			Min	DNA*	0.05	2.29	0.67	0.32	0.07	0.70	2.33	DNA*	0.23	0.47
			Excedance(Hour)	DNA*	0	0	0	0	0.00	0	0	DNA*	0	0
			Data capture(%)	DNA*	77	97	95	92	76	95	95	DNA*	74	98
CO-8hr	ppm	9	Average	DNA*	5.34	3.43	1.91	1.37	0.75	1.58	3.29	DNA*	0.61	1.13
			Max	DNA*	14.9	5.73	3.27	3.25	2.82	6.32	4.94	DNA*	0.92	2.78
			Min	DNA*	0.50	2.37	1.14	0.48	0.21	0.82	2.40	DNA*	0.47	0.70
			Excedance(Hour)	DNA*	84	0	0	0	0	0	0	DNA*	0	0
			Data capture(%)	DNA*	72	98	94	91	73	94	95	DNA*	73	97
O_3-1hr	ppb	120	Average	DNA*	9.06	DNA*	DNA*	9.01	DNA*	22.3	DNA*	11.4	20.3	12.1
			Max	DNA*	24.2	DNA*	DNA*	40.9	DNA*	86.7	DNA*	68.0	77.0	56.5
			Min	DNA*	4.89	DNA*	DNA*	0.89	DNA*	0.45	DNA*	0.73	0.34	0.64
			Excedance(Hour)	DNA*	0	DNA*	DNA*	0	DNA*	0	DNA*	0	0	0
			Data capture(%)	DNA*	90	DNA*	DNA*	92	DNA*	95	DNA*	98	100	98
O_3-8hr	ppb	80	Average	DNA*	9.07	DNA*	DNA*	8.88	DNA*	22.3	DNA*	11.5	20.4	12.1
			Max	DNA*	18.5	DNA*	DNA*	34.2	DNA*	78.3	DNA*	43.2	61.6	48.3
			Min	DNA*	5.26	DNA*	DNA*	1.23	DNA*	0.68	DNA*	1.03	1.86	1.24
			Excedance(Hour)	DNA*	0	DNA*	DNA*	0	DNA*	0	DNA*	0	0	0
			Data capture(%)	DNA*	89	DNA*	DNA*	91	DNA*	94	DNA*	95	99	97

CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, PM= Particulate Matter

a=Refurbisment CAMS, DNA= Data Not Available, *=DNA due to poor data capture rate or malfunction of the analyzer/sensor

ANNEX

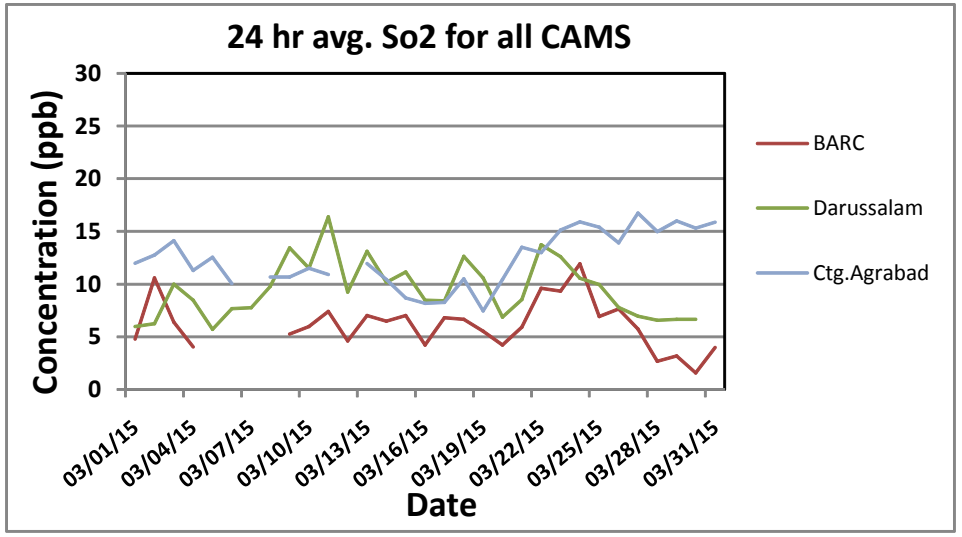
Table 3: Summary Air Quality and Meteorological data measured during March 2015 at different CAMS operated under DoE (Cont'd)

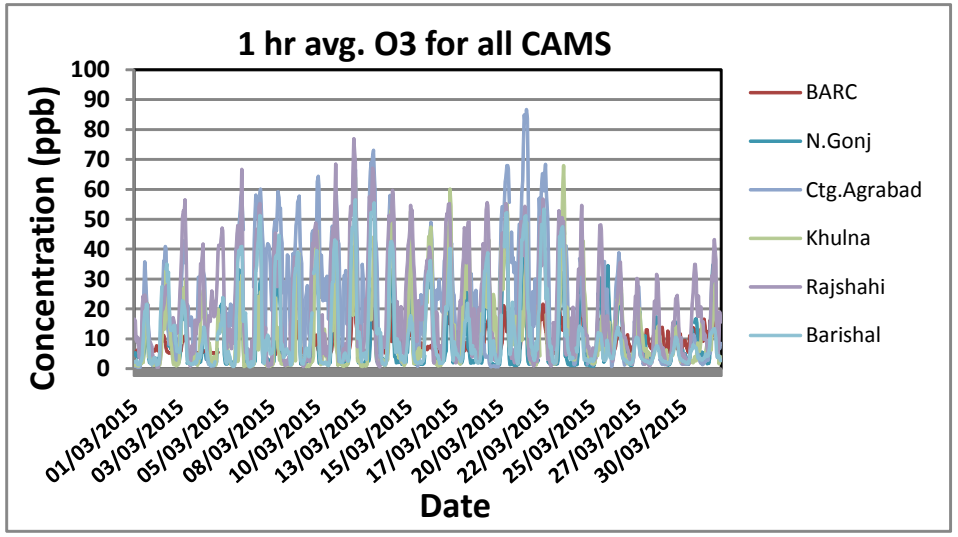
Parameter	unit	NAAQS	Summary	CAMS-1 (S-Bhaban)	CAMS-2 (BARC)[a]	CAMS-3 (D-salam)	CAMS-4 (Gazipur)	CAMS-5 (Narayonganj)	CAMS-6 TV-St (Chittagong)[a]	CAMS-7 Agrabad-(Chittagong)	CAMS-8 (Sylhet)	CAMS-9 (Khulna)[a]	CAMS-10 (Rajshahi)[a]	CAMS-11 (Barisal)
$PM_{2.5}$ -24hr	µg /m^3	65	Average	84.8	99.3	123	120	DNA*	DNA*	94.4	95.9	DNA*	DNA*	87.6
			Max	137	156	191	182	DNA*	DNA*	168	142	DNA*	DNA*	153
			Min	37.4	46.7	50.2	66.7	DNA*	DNA*	61.9	55.7	DNA*	DNA*	38.6
			Excedance(Days)	18	23	21	27	DNA*	DNA*	18	24	DNA*	DNA*	21
			Data capture(%)	78	90	84	84	DNA*	DNA*	78	86	DNA*	DNA*	92
PM_{10} -24hr	µg /m^3	150	Average	165	DNA*	235	244	312	DNA*	176	175	DNA*	DNA*	148
			Max	286	DNA*	362	372	466	DNA*	301	246	DNA*	DNA*	262
			Min	75.4	DNA*	104	107	130	DNA*	124	101	DNA*	DNA*	59.2
			Excedance(Days)	20	DNA*	18	27	20	DNA*	9	16	DNA*	DNA*	15
			Data capture(%)	96	DNA*	84	89	84	DNA*	74	73	DNA*	DNA*	91
Solar rad. 1hr	watt/m^2	NA	Average	171	DNA*	241	218	DNA*	DNA*	213	206	DNA*	DNA*	218
			Max	814	DNA*	993	890	DNA*	DNA*	890	857	DNA*	DNA*	883
			Min	6.28	DNA*	6.90	6.41	DNA*	DNA*	6.69	6.54	DNA*	DNA*	7.42
			Data capture(%)	97	DNA*	98	96	DNA*	DNA*	95	95	DNA*	DNA*	98
Relative Humidity 1hr	(%)	NA	Average	54.3	DNA*	53.0	60.5	55.7	DNA*	57.5	62.9	DNA*	DNA*	62.7
			Max	91.2	DNA*	91.3	94.4	91.0	DNA*	93.9	95.9	DNA*	DNA*	95.5
			Min	18.9	DNA*	19.2	19.8	24.5	DNA*	21.0	19.5	DNA*	DNA*	19.3
			Data capture(%)	97	DNA*	98	96	93	DNA*	95	95	DNA*	DNA*	98
Ambient Temp. 1hr	(°c)	NA	Average	23.9	25.4	27.3	25.2	DNA*	DNA*	26.5	24.9	DNA*	DNA*	27.6
			Max	34.1	35.3	36.0	34.9	DNA*	DNA*	33.8	34.5	DNA*	DNA*	36.7
			Min	14.0	16.7	18.3	14.7	DNA*	DNA*	19.3	16.3	DNA*	DNA*	17.6
			Data capture(%)	97	84	98	96	DNA*	DNA*	95	95	DNA*	DNA*	98
Rainfall 1hr	(m.m.)	NA	Average	1.08	DNA*	0.04	0.03	0.39	DNA*	0.05	DNA*	DNA*	DNA*	DNA*
			Max	4.39	DNA*	0.61	0.29	0.67	DNA*	4.83	DNA*	DNA*	DNA*	DNA*
			Min	0.27	DNA*	0.02	0.02	0.10	DNA*	0.02	DNA*	DNA*	DNA*	DNA*
			Data capture(%)	97	DNA*	79	58	93	DNA*	42	DNA*	DNA*	DNA*	DNA*

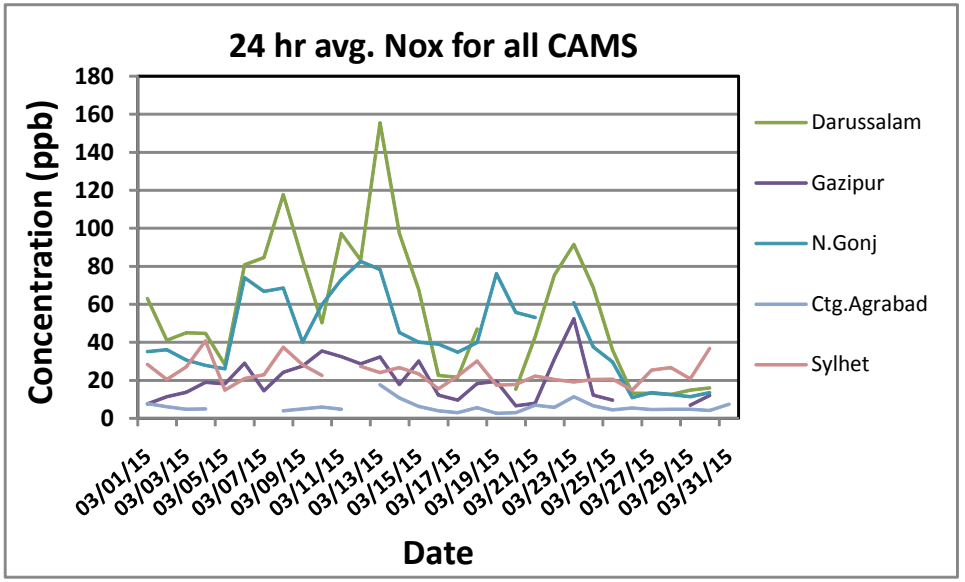
CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, PM= Particulate Matter

a=Refurbisment CAMS, DNA= Data Not Available, *=DNA due to poor data capture rate or malfunction of the analyzer/sensor

FIGURE 3: TIME SERIES OF ALL PARAMETERS (SO2, NOx AND O3) MEASURED IN ALL CAMS DURING MARCH, 2015







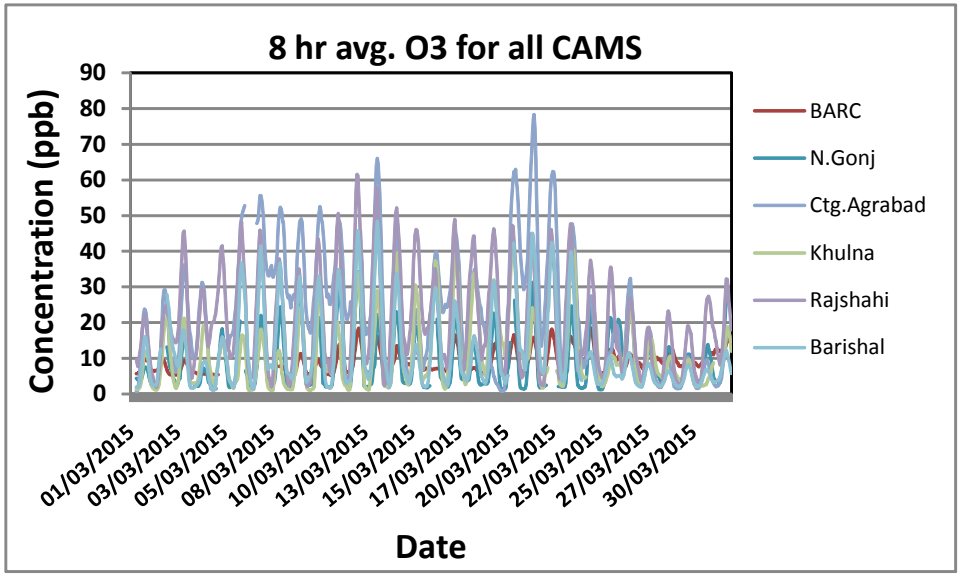
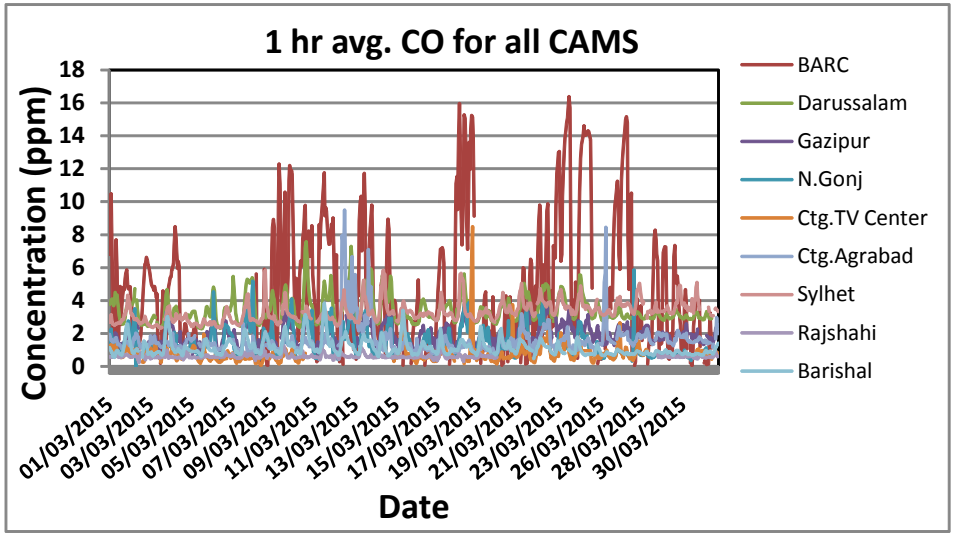
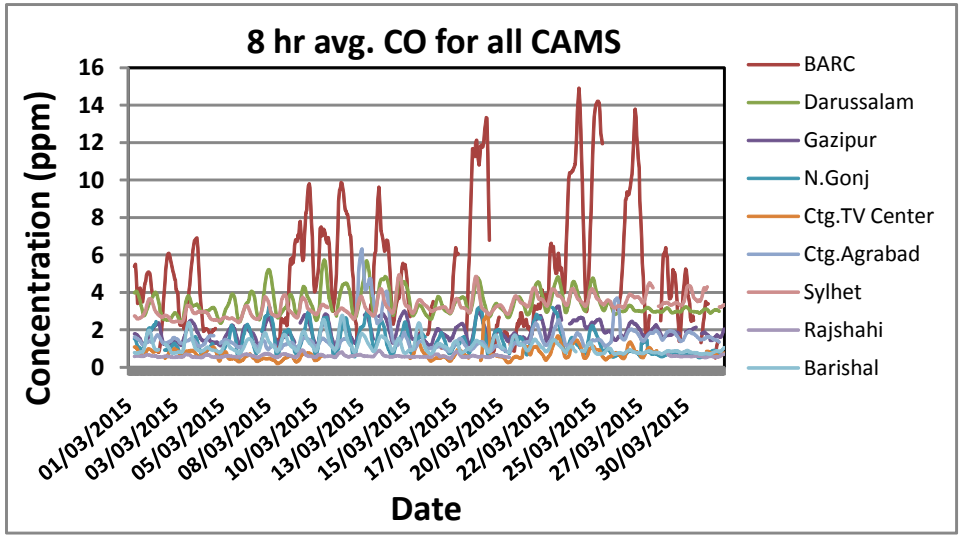
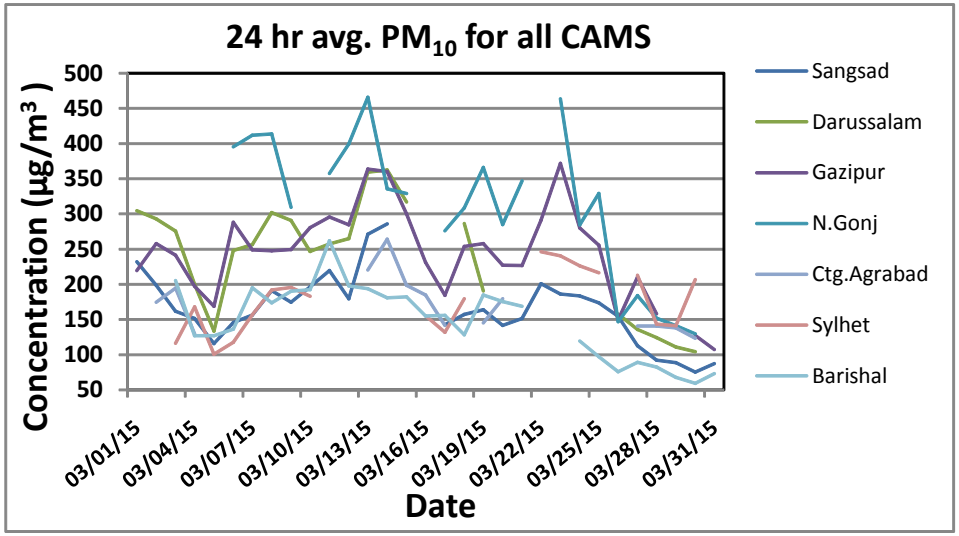


Figure 4: TIME SERIES OF ALL PARAMETERS (CO, PM10 AND PM2.5) MEASURED IN CAMS DURING MARCH, 2015







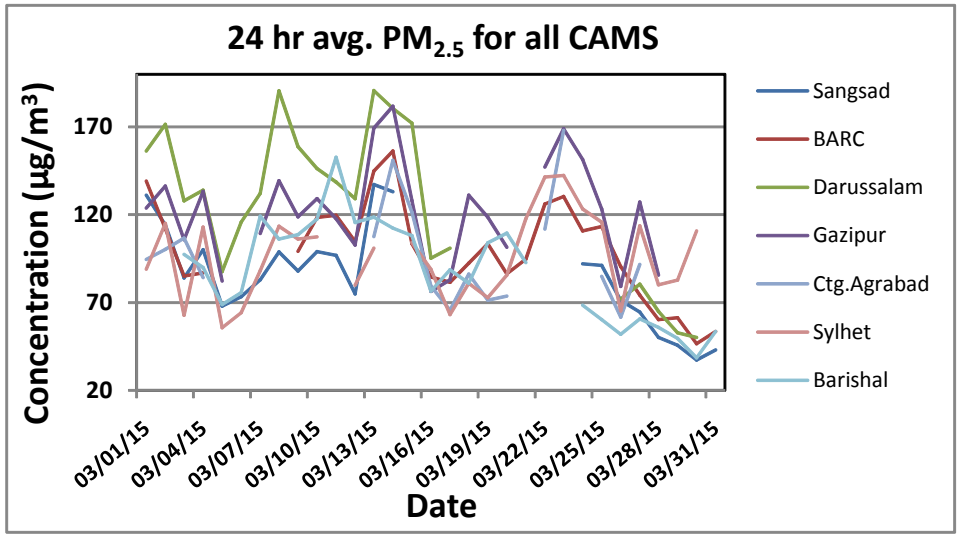


Figure 5: Monthly Summary of AQI for month of March, 2015