Air Quality Monthly Report

March, 2016

Department of Environment
Ministry of Environment, Forest and Climate Change
Bangladesh

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 in Table 2.

Table 2: Description of Monitoring Network:

City	ID	Location	Lat/Lon	Monitoring capacity
Dhaka	CAMS-1	Sangshad Bhaban, Sher-e-Bangla Nagar	23.76N 90.39E	PM10, PM2.5, CO, SO2, NOX, O3, and HC concentrations with meteorological parameters.
	CAMS-2	Farmgate	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.
Sylhet	CAMS-8	Red Crecent Campus	24.89N 91.87E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Khulna	CAMS-9	Baira	22.48N 89.53E	PM10, PM2.5, CO, SO2, NOX, O3, and HC with meteorological

City	ID	Location	Lat/Lon	Monitoring capacity
				parameters
Rajshahi	CAMS-10	Sopura	24.38N 88.61E	PM10, PM2.5, CO, SO2, NOX, O3, and HC with meteorological parameters.
Barisal	CAMS-11	DFO office campus	22.71N 90.36E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.

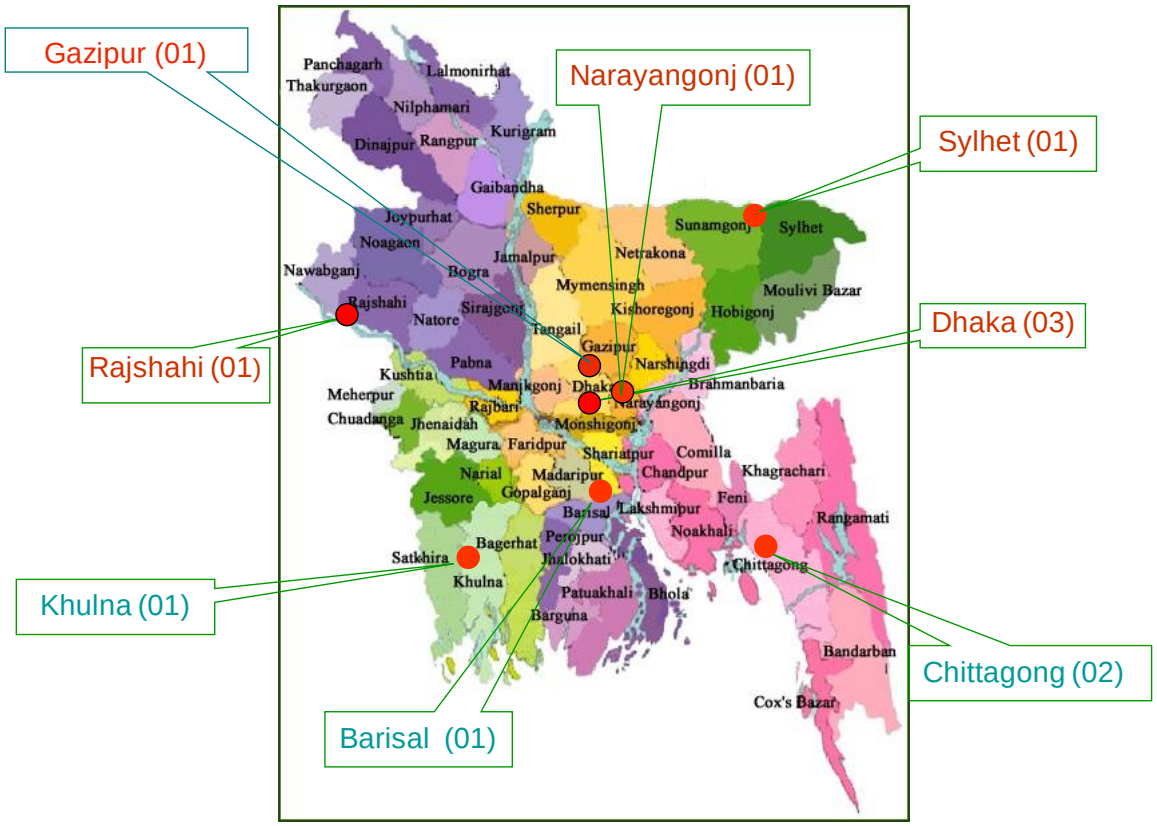


Figure 1: CAMS Location in Bangladesh

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, 2016 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.

Data availability (valid data) from those analyzers was functional found to be over 80% except few parameters in different CAMS in operation. During the reporting month several analyzers measuring gaseous pollutants (especially SO2) were not operational due to routine preventive/corrective maintenance. Data from Khulna CAMS not included in the report due to nonfunctional of Data logger monitor. In case of data capture rate for specific pollutant below 75% for a particular averaging time are reported in this month for Particulate Matter in major CAMS and all parameters at TV Chittagong CAMS.

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, 2016. It is observed that the 24 hr average concentration level of PM2.5 exceeded BNAAQS 25-27 days at Darussalam & Rajshahi CAMS, 20 days at BARC & Gazipur CAMS, 7-12 days at Barishal & Narayonganj CAMS respectively. Sangsad Bhaban, For PM10 non-attainment with respect to BNAAQS occurred for 19 days in Rajshahi & Gazipur CAMS, 9-10 days in Narayonganj CAMS & Darussalam CAMS, 04 days in Barshal CAMS in the reporting month. PM2.5 and PM10 results are not reported in the month for Sangsad Bhaban, TV Station CAMS, Agrabad, Chittagong, Sylhet and Khulna CAMS due to unavailability of filter paper. PM results of Narayonganj and Darussalam CAMS are reported though data capture rate below 50% in this month. The monthly average concentration level of PM2.5 and PM10 measured at different CAMS were found 78-113 µg/m3 and 126-270 µg/m^3 respectively during the month of March, 2016. That concentration level of those was found 109-153 µg/m3 and 165-317 µg/m^3 respectively during the month of February, 2016. From the time series plot of both PM10 and PM2.5, it is seen there are most of the episodes of PM concentrations lower than previous month. 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. 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, 2016. NOx concentrations exceeded the BNAAQS 19 days in Darussalam CAMS, 03 days in Narayonganj CAMS & 1 day in Sylhet CAMS in this month.

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, 2016. . 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 (valid data) from different CAMS and summary of the AQI by categories are presented in annex Figure 5. Summary data shows majority of the days AQI values were in unhealthy categories and few Very unhealthy and caution categories.

4. Summary and conclusion

Data obtained from CAMS operated under DoE air quality monitoring network during March, 2016 have been analyzed and reported. Data availability was 65-80% 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:

- Although PM_{10} and $PM_{2,5}$ are the most critical pollutants but 24-hour average for both PM10 and PM2.5 concentrations during reporting month were found slightly lower than previous month. It is observed that the average concentration level of PM2.5 and PM10 measured at different CAMS were 78-113 µg/m3 and 126-270 µg/m^3 respectively during the month of March, 2016.
- The gaseous pollutants except NOx measured at different CAMS did not exceed limit values of the BNAAQS. NOx concentrations exceeded the BNAAQS BNAAQS 19

days in Darussalam CAMS, 03 days in Narayonganj CAMS & 1 day in Sylhet CAMS in this month.

- Due to increasing average wind speed and precipitation during March, 2016, dispersion and wash out of pollutants increases and thus the pollution concentration level decreases.
- 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 caution categories as well. In all cases most frequent responsible pollutant was PM2.5. In absence of PM2.5 sometimes found responsible pollutant PM10 and responsible pollutant NOx found sometimes in those CAMS near to main road.

During the reporting month number of analyzer especially SO2 of new CAMS did not produced good data and they are under maintenance process.

ANNEX

Table 3: Summary Air Quality and Meteorological data measured during March, 2016 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*	11.2	14.1	29.9	DNA*	3.79	16.8	DNA*	DNA[1]	DNA*	DNA*
			Max	DNA*	27.5	31.8	69.5	DNA*	8.59	88.7	DNA*	DNA[1]	DNA*	DNA*
			Min	DNA*	2.31	6.25	1.41	DNA*	2.12	2.38	DNA*	DNA[1]	DNA*	DNA*
			Excedance(Days)	DNA*	0	0	0	DNA*	0	0	DNA*	DNA[1]	DNA*	DNA*
			Data capture(%)	DNA*	89	95	85	DNA*	32	72	DNA*	DNA[1]	DNA*	DNA*
NO_2 -24 hr	ppb	53 (Annual)	Average	DNA*	DNA*	64.2	16.6	28.8	DNA*	4.44	33	DNA[1]	DNA*	4.90
			Max	DNA*	DNA*	181	40.2	78.9	DNA*	9.53	63	DNA[1]	DNA*	13.9
			Min	DNA*	DNA*	21.6	3.64	9.27	DNA*	0.88	13.6	DNA[1]	DNA*	0.84
			Excedance(Days)	DNA*	DNA*	19	0	3	DNA*	0	1	DNA[1]	DNA*	0
			Data capture(%)	DNA*	DNA*	94	86	89	DNA*	74	51	DNA[1]	DNA*	91
CO- 1 hr	ppm	35	Average	2.33	1.43	DNA*	1.31	DNA*	0.73	0.84	0.93	DNA[1]	1.00	1.17
			Max	5.59	8.27	DNA*	2.7	DNA*	3.25	3.20	4.55	DNA[1]	3.25	14.9
			Min	0.18	0.05	DNA*	0.70	DNA*	0.05	0.05	0.11	DNA[1]	0.31	0.65
			Excedance(Hour)	0	0	DNA*	0	DNA*	0	0	0	DNA[1]	0	0
			Data capture(%)	100	91	DNA*	83	DNA*	42	92	52	DNA[1]	98	50
CO-8hr	ppm	9	Average	2.33	1.45	DNA*	1.14	DNA*	0.73	0.84	0.93	DNA[1]	1.00	1.18
			Max	5.06	4.84	DNA*	1.14	DNA*	2.59	2.61	2.07	DNA[1]	2.28	3.08
			Min	0.31	0.24	DNA*	1.14	DNA*	0.15	0.16	0.28	DNA[1]	0.46	0.72
			Excedance(Hour)	0	0	DNA*	0	DNA*	0	0	0	DNA[1]	0	0
			Data capture(%)	99	88	DNA*	0	DNA*	39	88	51	DNA[1]	96	51
O_3-1hr	ppb	120	Average	DNA*	DNA*	7.81	DNA*	9.34	7.43	19.9	26.8	DNA[1]	4.12	DNA*
			Max	DNA*	DNA*	98.1	DNA*	55.3	29.7	85.8	85.9	DNA[1]	66.3	DNA*
			Min	DNA*	DNA*	0.72	DNA*	1.35	1.90	0.05	0.05	DNA[1]	1.25	DNA*
			Excedance(Hour)	DNA*	DNA*	0	DNA*	0	0	0	0	DNA[1]	0	DNA*
			Data capture(%)	DNA*	DNA*	95	DNA*	88	44	95	51	DNA[1]	98	DNA*
O_3-8hr	ppb	80	Average	DNA*	DNA*	7.87	DNA*	9.43	7.29	19.9	26.9	DNA[1]	4.02	DNA*
			Max	DNA*	DNA*	34.9	DNA*	44.3	25.3	68.8	70.0	DNA[1]	48.1	DNA*
			Min	DNA*	DNA*	0.94	DNA*	1.82	2.12	0.24	1.14	DNA[1]	1.74	DNA*
			Excedance(Hour)	DNA*	DNA*	0	DNA*	0	0	0	0	DNA[1]	0	DNA*
			Data capture(%)	DNA*	DNA*	96	DNA*	86	42	92	51	DNA[1]	97	DNA*

CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, a=Refurbisment CAMS, PM= Particulate Matter
DNA= Data Not Available, 1= DNA due to malfunction of station data logger monitor, *=DNA due to malfunction of the analyzer/sensor/ poor data capture rate

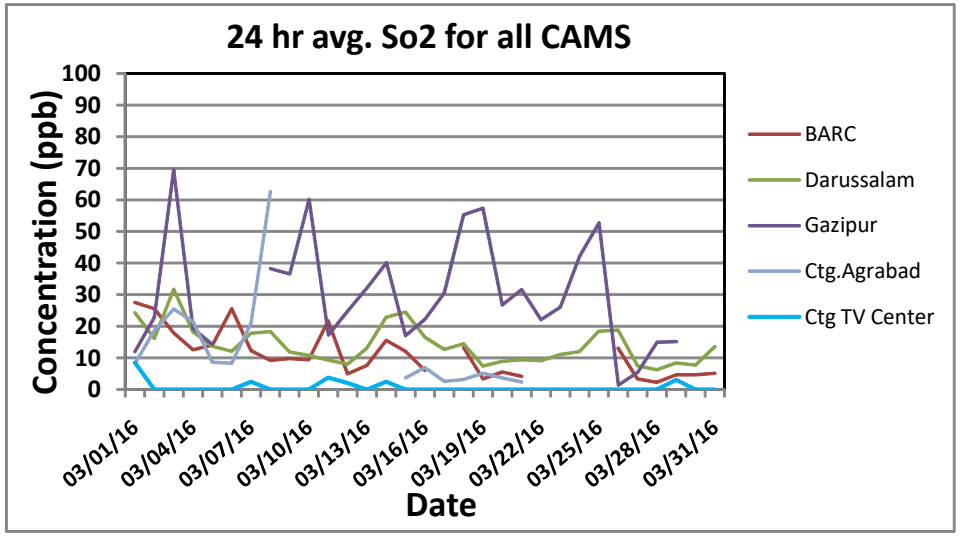
Table 3: Summary Air Quality and Meteorological data measured during March, 2016 at different CAMS operated under DoE (Cont'd)

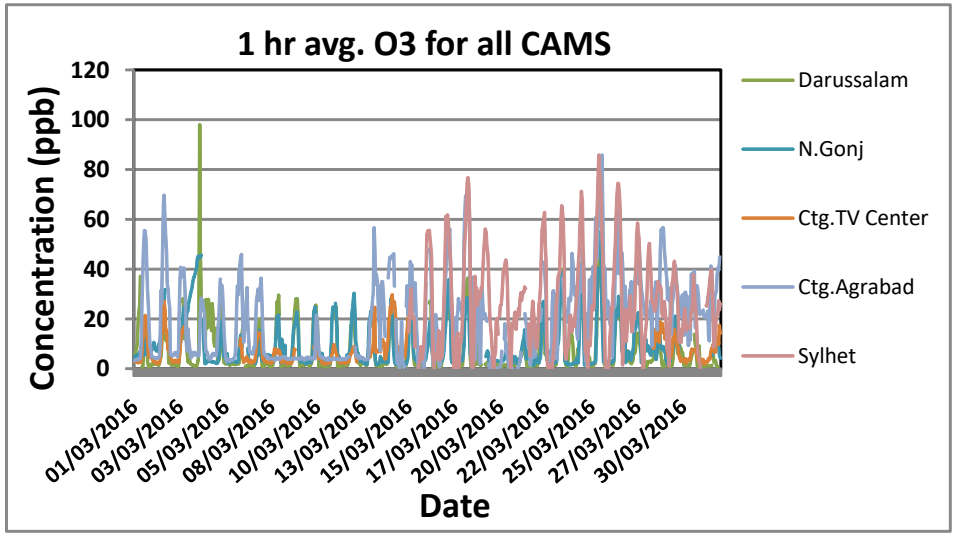
Parameter	unit	NAAQS	Summary	CAMS-1 (S-Bhaban)	CAMS-2 (BARC)[a]	CAMS-3 (D-salam)	CAMS-4 (Gazipur)	CAMS-5 (Narayonganj)	CAMS-6 TV-St (Chittagong)[a]	CAMS-7 Agrabad-(Chittagong)	CAMS-8 (Sylhet)	CAMS-9 (Khulna)[a]	CAMS-10 (Rajshahi)[a]	CAMS-11 (Barisal)
$PM_{2.5}$ -24hr	µg /m^3	65	Average	DNA*	97.4	113	112	113	DNA*	DNA*	DNA*	DNA[1]	82.7	78.2
			Max	DNA*	143	247	175	220	DNA*	DNA*	DNA*	DNA[1]	131	139
			Min	DNA*	59.4	48.2	37.9	74.2	DNA*	DNA*	DNA*	DNA[1]	44.1	27.7
			Excedance(Days)	DNA*	20	27	20	7	DNA*	DNA*	DNA*	DNA[1]	25	12
			Data capture(%)	DNA*	72	89	79	26	DNA*	DNA*	DNA*	DNA[1]	98	54
PM_{10} -24hr	µg /m^3	150	Average	DNA*	DNA*	270	199	258	DNA*	DNA*	DNA*	DNA[1]	171	126
			Max	DNA*	DNA*	476	296	472	DNA*	DNA*	DNA*	DNA[1]	267	170
			Min	DNA*	DNA*	192	62.3	171	DNA*	DNA*	DNA*	DNA[1]	102	80.0
			Excedance(Days)	DNA*	DNA*	9	19	10	DNA*	DNA*	DNA*	DNA[1]	19	4
			Data capture(%)	DNA*	DNA*	29	79	34	DNA*	DNA*	DNA*	DNA[1]	98	54
Solar rad. 1hr	watt/m^2	NA	Average	125	DNA*	201	28.9	127	DNA*	166	191	DNA[1]	144	190
			Max	720	DNA*	948	653	391	DNA*	794	880	DNA[1]	850	834
			Min	4.68	DNA*	6.11	0.05	16.5	DNA*	6.77	6.42	DNA[1]	0.85	7.93
			Data capture(%)	100	DNA*	97	72	94	DNA*	97	98	DNA[1]	99	91
Relative Humidity 1hr	(%)	NA	Average	61.0	46.1	59.9	DNA*	64.5	69.8	69.4	67.5	DNA[1]	62.7	71.2
			Max	91.0	94.2	91.2	DNA*	91.0	97.8	93.6	96.0	DNA[1]	100	97.1
			Min	15.4	9.07	15.7	DNA*	23.9	27.6	25.4	21.6	DNA[1]	12.4	17.2
			Data capture(%)	100	71	97	DNA*	94	44	97	98	DNA[1]	90	91
Ambient Temp. 1hr	(°c)	NA	Average	25.0	23.7	28.1	25.2	DNA*	25.4	27.2	25.6	DNA[1]	27.9	29.0
			Max	33.3	34.3	35.1	32.6	DNA*	32.2	33.8	33.6	DNA[1]	37.1	37.6
			Min	17.6	20.8	20.9	19.6	DNA*	19.2	20.9	19.2	DNA[1]	20.0	22.0
			Data capture(%)	100	72	97	14	DNA*	0	97	98	DNA[1]	99	91
Rainfall 1hr	(m.m.)	NA	Average	0.95	1.54	0.19	1.77	0.36	DNA*	0.02	0.18	DNA[1]	DNA*	DNA*
			Max	3.84	5.58	36.3	3.99	0.67	DNA*	0.50	20.7	DNA[1]	DNA*	DNA*
			Min	0.20	0.03	0.02	0.02	0.08	DNA*	0.02	0.02	DNA[1]	DNA*	DNA*
			Data capture(%)	100	61	49	79	94	DNA*	62	37	DNA[1]	DNA*	DNA*

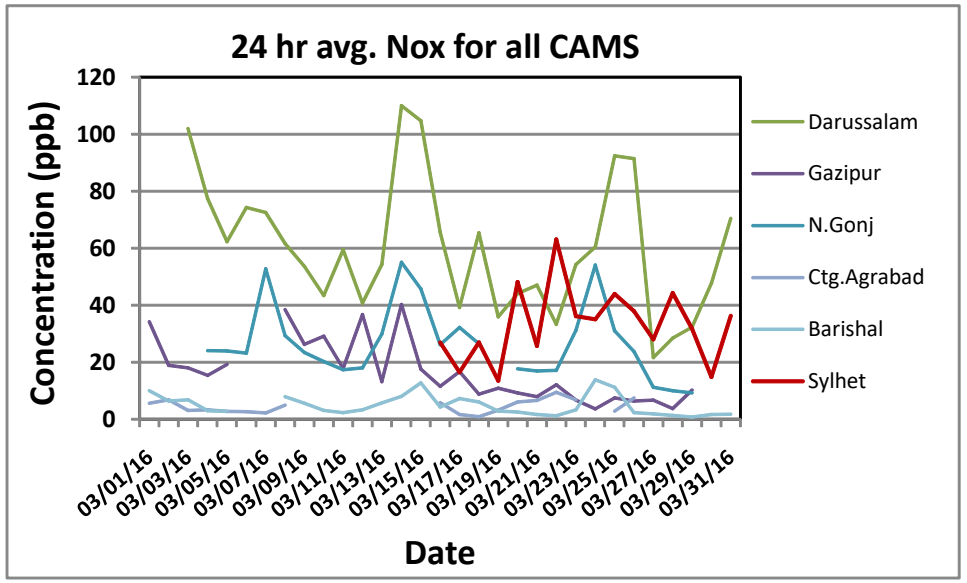
CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, a=Refurbisment CAMS, PM= Particulate Matter

DNA= Data Not Available, 1= DNA due to malfunction of station data logger monitor, *=DNA due to malfunction of the analyzer/sensor/ poor data capture rate

FIGURE 3: TIME SERIES OF ALL PARAMETERS (SO2,NOx AND O3) MEASURED IN ALL CAMS DURING MARCH, 2016







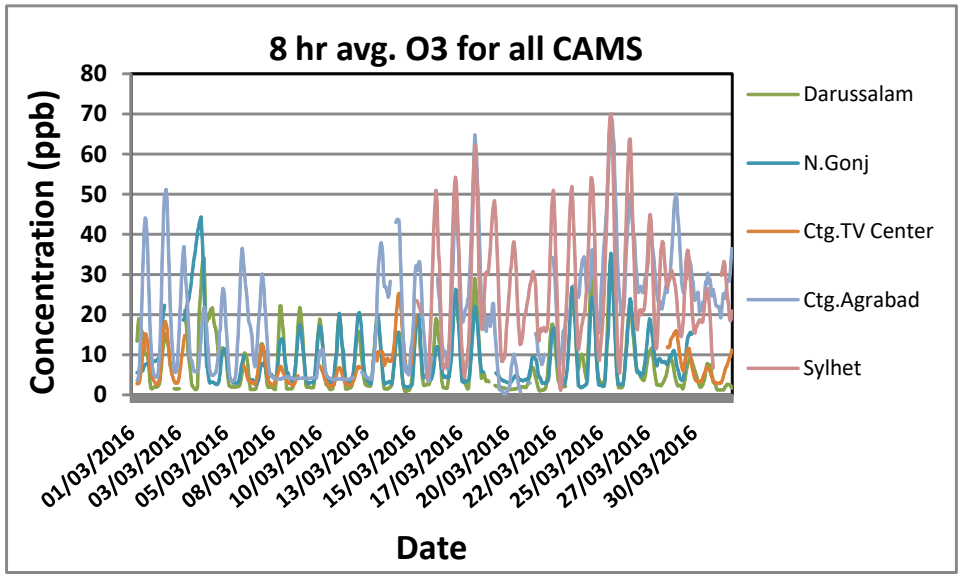
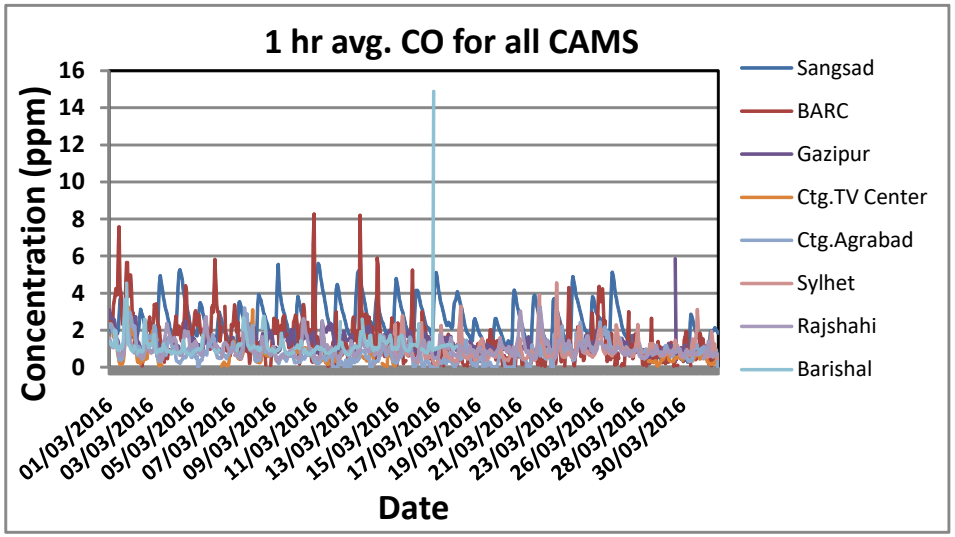
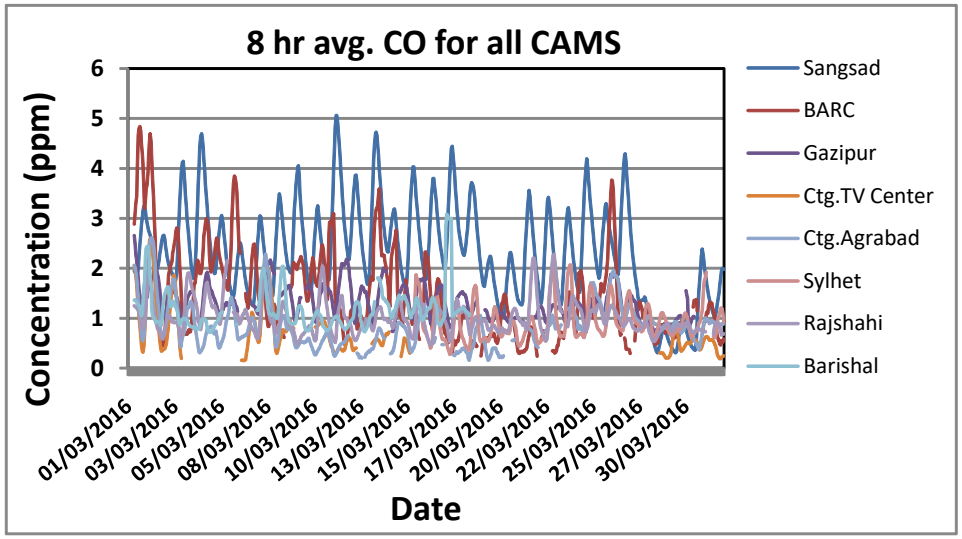
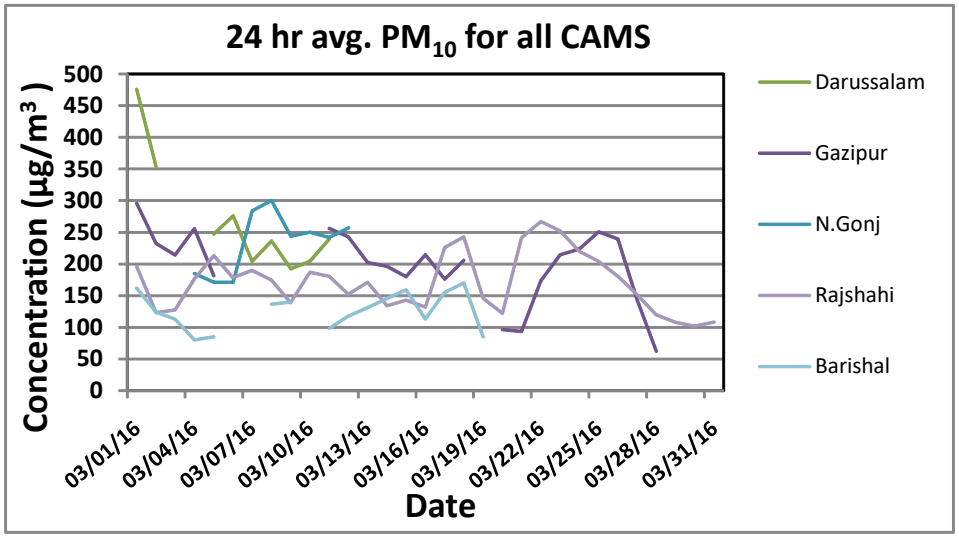


Figure 4: TIME SERIES OF ALL PARAMETERS (CO, PM10 AND PM2.5) MEASURED IN CAMS DURING MARCH, 2016







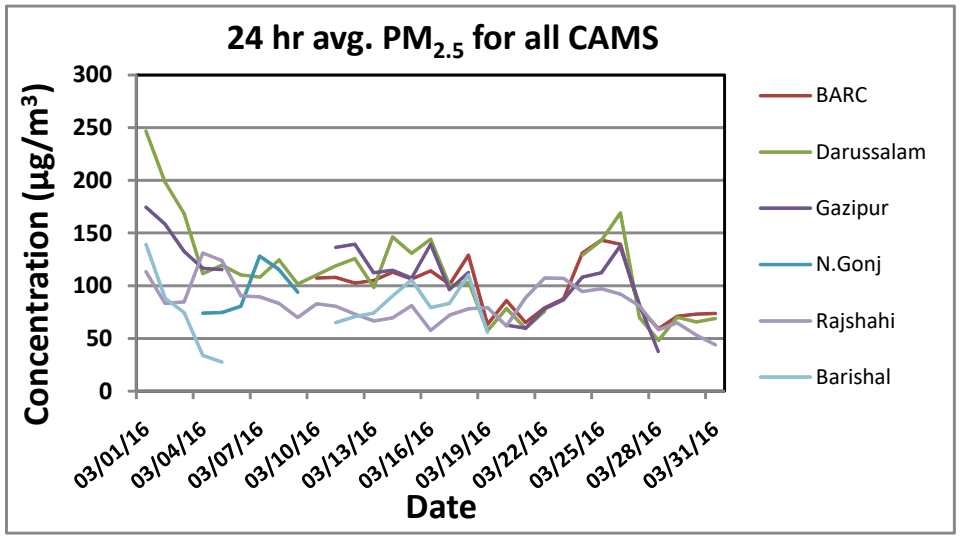


Figure 5: Monthly Summary of AQI for month of March, 2016