Government of the People's Republic of Bangladesh

Ministry of Environment and Forests

Monthly Air Quality Monitoring Report
Reporting Month: September, 2017

Clean Air and Sustainable Environment Project
(নির্মল বায়ু এবং টেকসই পরিবেশ প্রকল্প)

October, 2017

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.

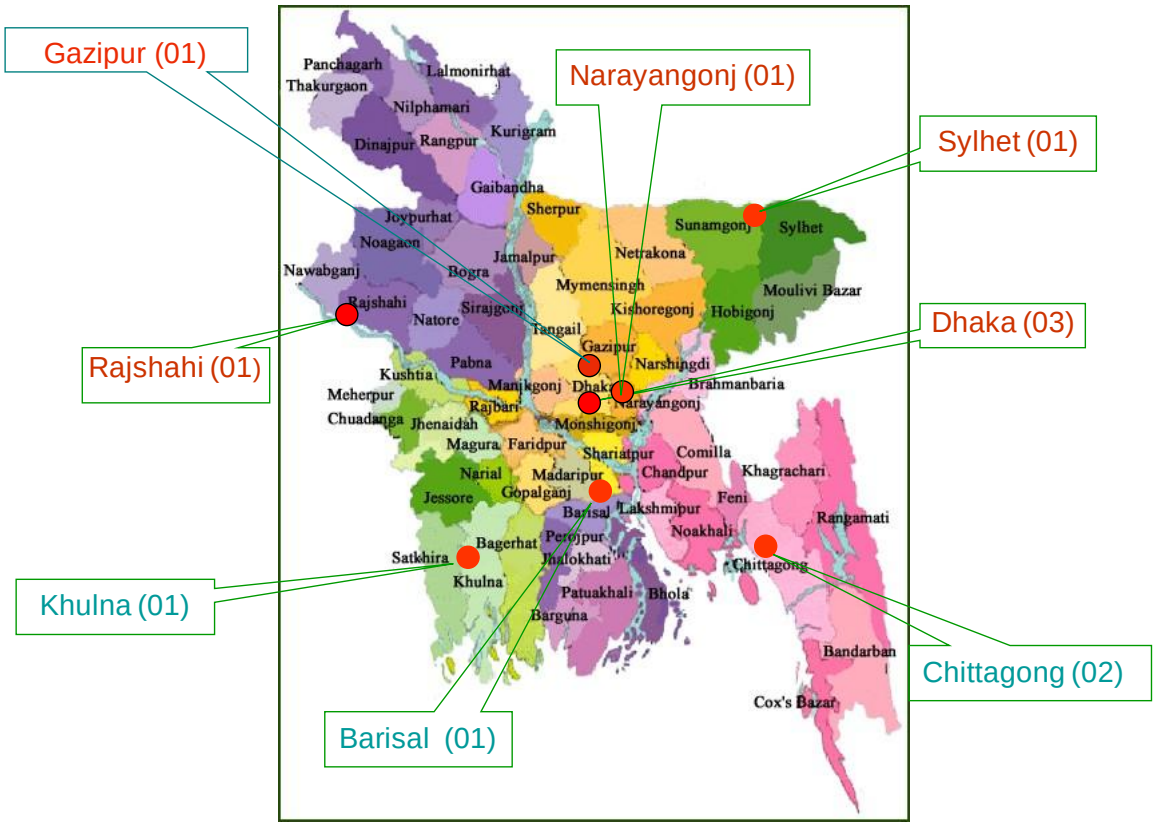


Figure 1: CAMS Location in Bangladesh

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 results of air quality parameters during the month of September, 2017 from 11 CAMS operated by 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 capture rate found little bit low compare to the previous month except few parameters in some CAMS in operation. During the reporting month several analyzers (especially SO2) were not functional due to routine preventive/corrective maintenance.

Inspection of the available data shows that there were few occurrences of non-compliance for PM10& PM2.5 levels at all monitoring stations during the month of September, 2017. It is observed that the 24 hr average concentration level of PM2.5 exceeded BNAAQS for 04-05 days in BARC, Darussalam & Narayonganj CAMS, 01 day in Khulna CAMS and 02 day at Sangsad Bhavan CAMS during the month of September, 2017. For PM10 non-attainment with respect to BNAAQS occurred for 8 days at Narayonganj CAMS and 01 day at D.Salam CAMS during the reporting month. The monthly average concentration level of PM2.5 and PM10 measured at different CAMS were found 19.7-46.79 µg/m3 and 42.65-118 µg/m^3 respectively during the monitoring month of September, 2017. The concentration level of those was found 18.91-41.30 µg/m3 and 38.66-130.85 µg/m^3 respectively during the month of August, 2017. From the time series plot of both PM10 and PM2.5, it is seen in most cases PM concentrations lower than the BNAAQS. 24-hours average PM levels in all cities monitored are decreasing compared to previous month because of more rains and some other meteorological conditions especially more wind speed which dilutes the PM concentrations. It is also observed that gaseous pollutants measured at different CAMS did not exceed the BNAAQS during the month of September, 2017.

In general PM pollution levels in the cities monitored during the reporting month found slightly higher 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 September, 2017. It is observed that average wind speed and precipitation compared to previous month has an 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 Figure 5. Summary data shows majority of the days AQI values were in good & moderate and few caution and unhealthy categories.

4. Summary and conclusion

Data obtained from CAMS operated under DoE air quality monitoring network during September, 2017 have been analyzed and reported. Data availability was 70-90% for all the criteria pollutants monitored at different CAMS with few exception. 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 mostly lower than the BNAAQS during the month of July, 2017 with few exceptions. It is observed that the average concentration level of PM2.5 and PM10 measured at different CAMS were 19.7-46.79 µg/m3 and 42.65-118 µg/m^3respectively during the month of September, 2017.
- The gaseous pollutants measured at different CAMS did not exceed limit values of the BNAAQS.
- Due to increasing average wind speed and increasing precipitation during September, 2017, dispersion and wash out of pollutants increases and thus the pollution concentration levels showed lower.
- 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 good or moderate

along with some caution and unhealthy categories. In all cases most frequent responsible pollutant was either PM2.5 or PM10.

During the reporting month number of analyzer especially gaseous analyzers of some CAMS did not produced data because of their repair and maintenance activities.

ANNEX

Table 3: Summary Air Quality and Meteorological data measured during September, 2017 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	DNA	1.20	DNA	DNA	DNA	1.09	DNA	DNA	DNA	2.83
			Max	DNA	DNA	2.95	DNA	DNA	DNA	1.96	DNA	DNA	DNA	4.44
			Min	DNA	DNA	0.17	DNA	DNA	DNA	0.33	DNA	DNA	DNA	1.21
			Excedance(Days)	DNA	DNA	0	DNA	DNA	DNA	0	DNA	DNA	DNA	0
			Data capture(%)	DNA	DNA	58	DNA	DNA	DNA	61	DNA	DNA	DNA	87
NO_2 -24 hr	ppb	53 (Annual)	Average	DNA	59.0	DNA	DNA	37.9	DNA	12.9	9.54	DNA	DNA	7.37
			Max	DNA	95.7	DNA	DNA	95.0	DNA	27.2	31.2	DNA	DNA	14.8
			Min	DNA	41.1	DNA	DNA	5.78	DNA	2.91	5.37	DNA	DNA	4.11
			Excedance(Days)	DNA	0	DNA	DNA	0	DNA	0	0	DNA	DNA	0
			Data capture(%)	DNA	32	1	DNA	40	DNA	51	91	DNA	DNA	82
CO- 1 hr	ppm	35	Average	1.80	1.54	0.90	DNA	DNA	0.29	2.97	DNA	0.49	DNA	0.45
			Max	4.57	17.2	2.77	DNA	DNA	0.54	7.59	DNA	2.13	DNA	2.35
			Min	0.24	0.05	0.07	DNA	DNA	0.08	0.05	DNA	0.05	DNA	0.05
			Excedance(Hour)	0	0	0	DNA	DNA	0	0	DNA	0	DNA	0
			Data capture(%)	67	74	62	DNA	DNA	4	76	DNA	6	DNA	11
CO-8hr	ppm	9	Average	1.80	1.55	0.92	DNA	DNA	0.30	2.89	DNA	0.35	DNA	0.44
			Max	3.91	6.81	2.46	DNA	DNA	0.45	5.49	DNA	1.21	DNA	1.73
			Min	0.61	0.10	0.21	DNA	DNA	0.17	0.39	DNA	0.09	DNA	0.17
			Excedance(Hour)	0	0	0	DNA	DNA	0	0	DNA	0	DNA	0
			Data capture(%)	66	71	60	DNA	DNA	2	70	DNA	4	DNA	9
O_3-1hr	ppb	120	Average	DNA	4.98	2.00	DNA	1.98	3.47	13.3	6.63	DNA	6.89	3.80
			Max	DNA	14.9	16.0	DNA	11.2	11.0	92.5	26.8	DNA	31.1	14.1
			Min	DNA	0.83	0.68	DNA	0.26	0.96	3.06	0.05	DNA	1.00	0.76
			Excedance(Hour)	DNA	0	0	DNA	0	0	0	0	DNA	0	0
			Data capture(%)	DNA	59	96	DNA	22	20	47	37	DNA	76	15
O_3-8hr	ppb	80	Average	DNA	4.98	2.02	DNA	1.90	3.41	13.4	6.88	DNA	6.86	4.03
			Max	DNA	8.65	10.1	DNA	7.42	6.43	53.4	23.2	DNA	14.5	7.81
			Min	DNA	1.76	0.83	DNA	0.32	2.56	8.49	2.12	DNA	2.45	1.07
			Excedance(Hour)	DNA	0	0	DNA	0	0	0	0	DNA	0	0
			Data capture(%)	DNA	58	96	DNA	22	16	40	34	DNA	70	14

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

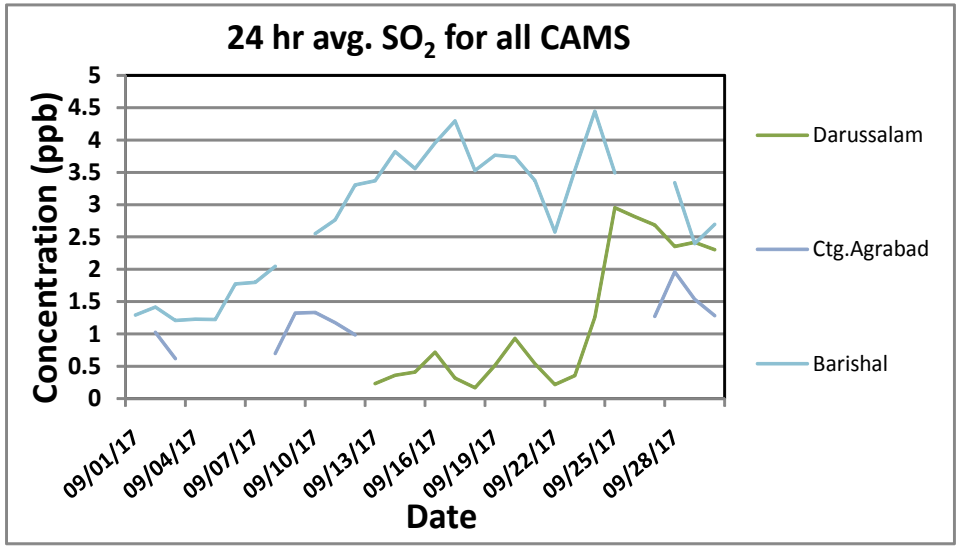
Table 3: Summary Air Quality and Meteorological data measured during September, 2017 at different CAMS operated under DoE (Cont'd)

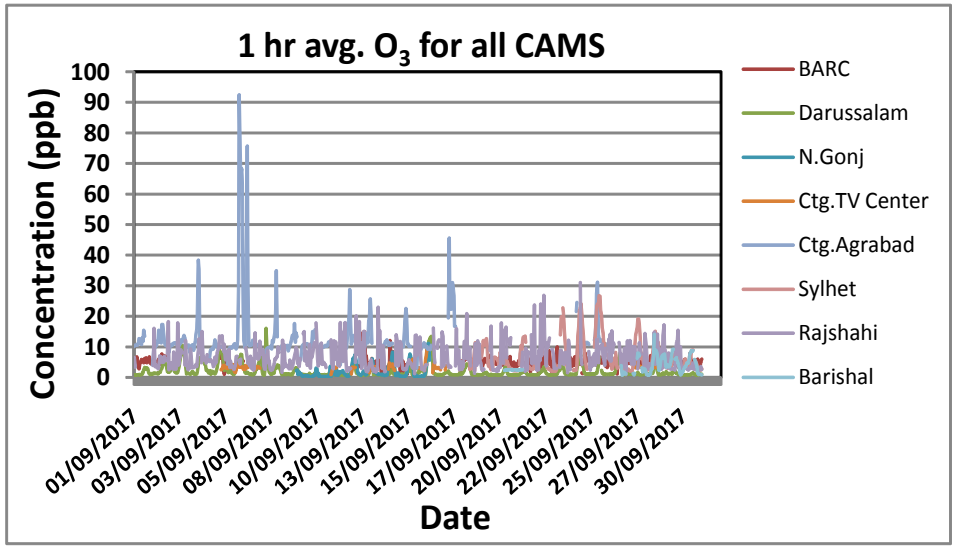
Parameter	unit	NAAQS	Summary	CAMS-1 (S-Bhaban)	CAMS-2 (BARC)[a]	CAMS-3 (D-salam)	CAMS-4 (Gazipur)	CAMS-5 (Narayonganj)	CAMS-6 TV-St (Chittagong)[a]	CAMS-7 Agrabad-(Chittagong)	CAMS-8 (Sylhet)	CAMS-9 (Khulna)[a]	CAMS-10 (Rajshahi)[a]	CAMS-11 (Barisal)
$PM_{2.5}$ -24hr	µg /m^3	65	Average	36.5	46.7	40.8	26.7	45.6	33.4	DNA	23.5	30.4	19.8	27.8
			Max	68.7	85.8	87.4	40.1	117.2	41.4	DNA	43.3	66.9	35.0	54.9
			Min	12.6	17.9	18.8	15.5	14.7	21.4	DNA	6.12	11.4	9.28	11.9
			Excedance(Days)	2	5	4	0	5	0	DNA	0	1	0	0
			Data capture(%)	67	80	95	17	37	8	DNA	72	30	54	32
PM_{10} -24hr	µg /m^3	150	Average	DNA	63.7	76.9	42.6	118	47.7	48.0	46.0	DNA	101	42.7
			Max	DNA	120	159	58.4	224	65.1	95.9	82.3	DNA	156	67.4
			Min	DNA	19.7	30.7	23.7	25.3	29.7	22.3	15.1	DNA	52.8	21.6
			Excedance(Days)	DNA	0	1	0	8	0	0	0	DNA	2	0
			Data capture(%)	1	83	95	17	73	7	66	79	DNA	70	10
Solar rad. 1hr	watt/m^2	NA	Average	103	DNA	171	56.8	DNA	96.1	167	154	153	151	140
			Max	732	DNA	989	913	DNA	97.8	941	913	437	525	896
			Min	5.30	DNA	6.25	0.88	DNA	78.8	7.17	5.45	1.27	121	7.92
			Data capture(%)	67	DNA	96	59	DNA	20	78	92	1	71	89
Relative Humidity 1hr	(%)	NA	Average	79.7	57.2	78.1	81.2	DNA	96.1	82.7	87.2	DNA	81.6	87.1
			Max	92.4	67.6	93.2	92.0	DNA	97.8	94.4	98.5	DNA	86.5	97.9
			Min	47.5	30.2	49.1	52.4	DNA	78.8	58.5	55.9	DNA	79.5	50.8
			Data capture(%)	67	87	96	16	DNA	20	78	92	DNA	71	89
Ambient Temp. 1hr	(°c)	NA	Average	26.5	27.0	29.6	29.1	DNA	25.5	27.9	28.1	DNA	DNA	29.5
			Max	33.4	37.3	36.6	34.8	DNA	31.3	33.7	35.3	DNA	DNA	38.5
			Min	22.1	15.4	24.8	26.4	DNA	15.1	24.6	23.7	DNA	DNA	25.6
			Data capture(%)	67	87	96	16	DNA	20	78	92	DNA	DNA	89
Rainfall 1hr	(m.m.)	NA	Average	1.29	1.36	DNA	1.50	DNA	DNA	0.26	0.45	DNA	DNA	0.79
			Max	5.56	9.00	DNA	22.0	DNA	DNA	17.0	7.42	DNA	DNA	15.6
			Min	0.02	0.03	DNA	0.02	DNA	DNA	0.02	0.02	DNA	DNA	0.02
			Data capture(%)	62	57	DNA	49	DNA	DNA	60	52	DNA	DNA	3

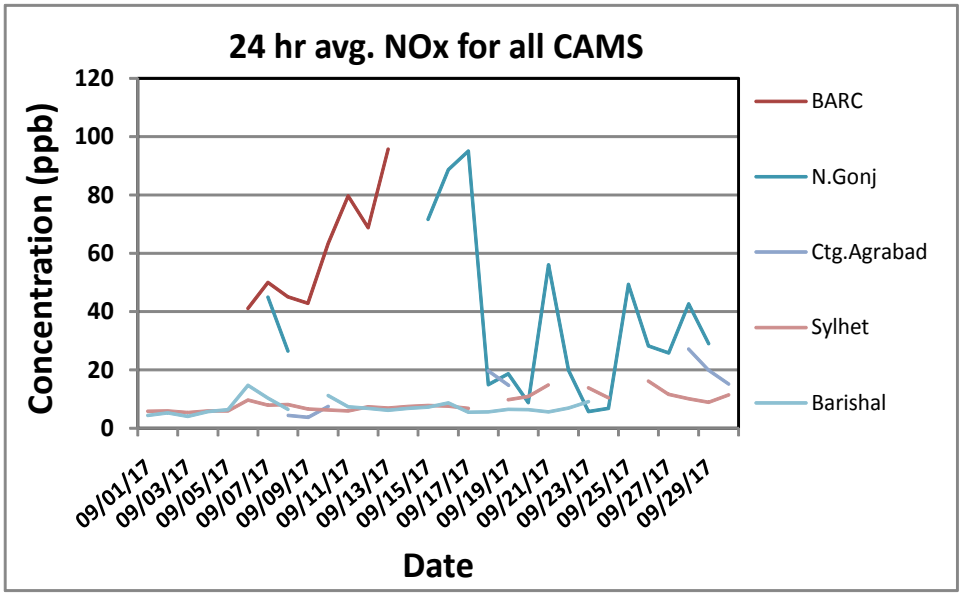
CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, a=Refurbisment CAMS, PM= Particulate Matter

DNA= Data Not Available 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 September, 2017







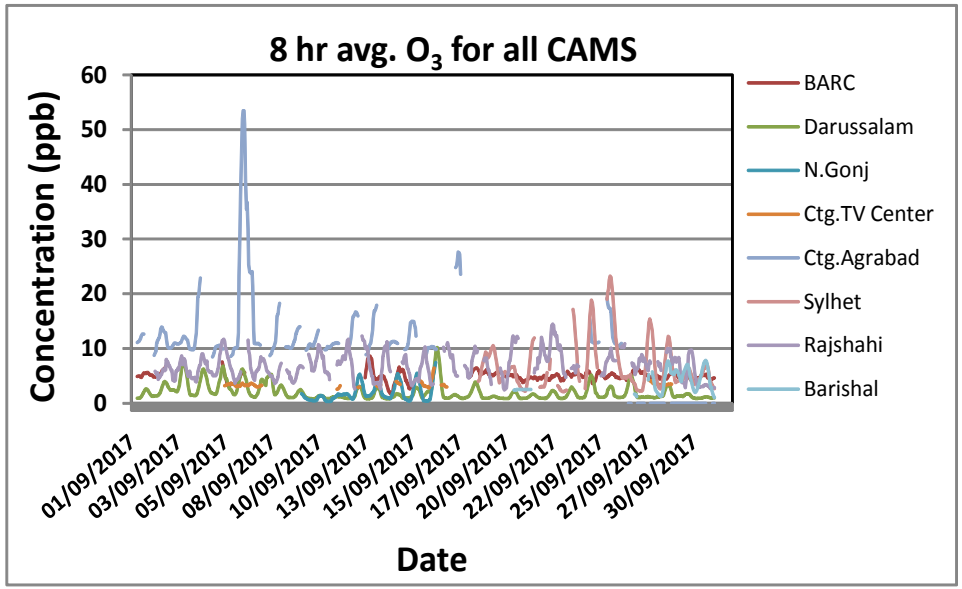
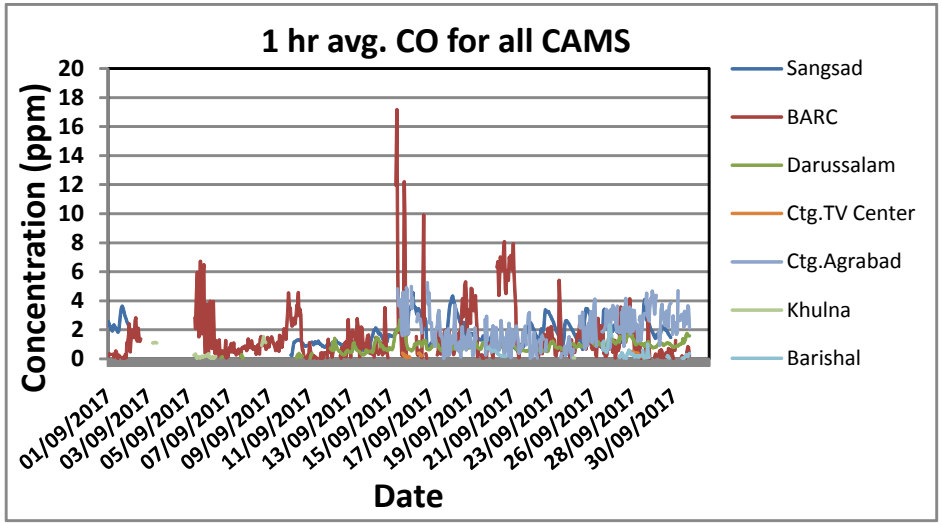
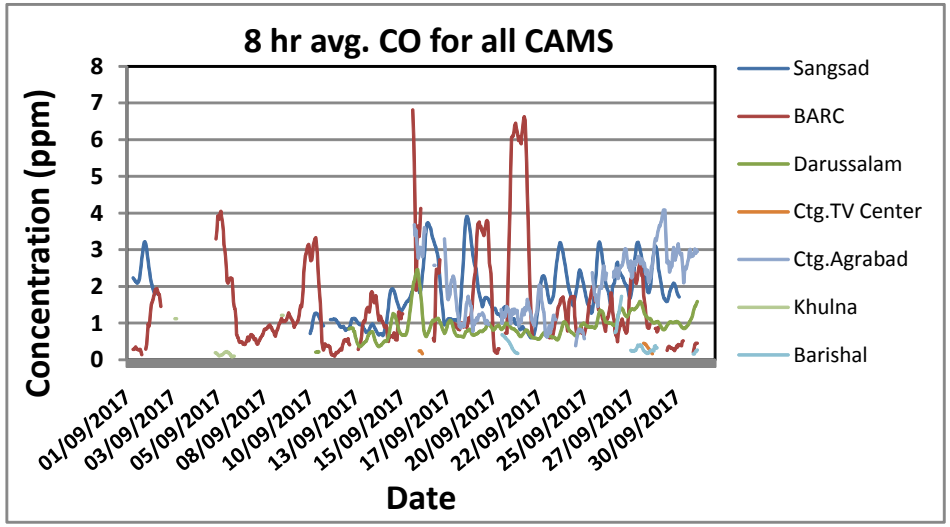
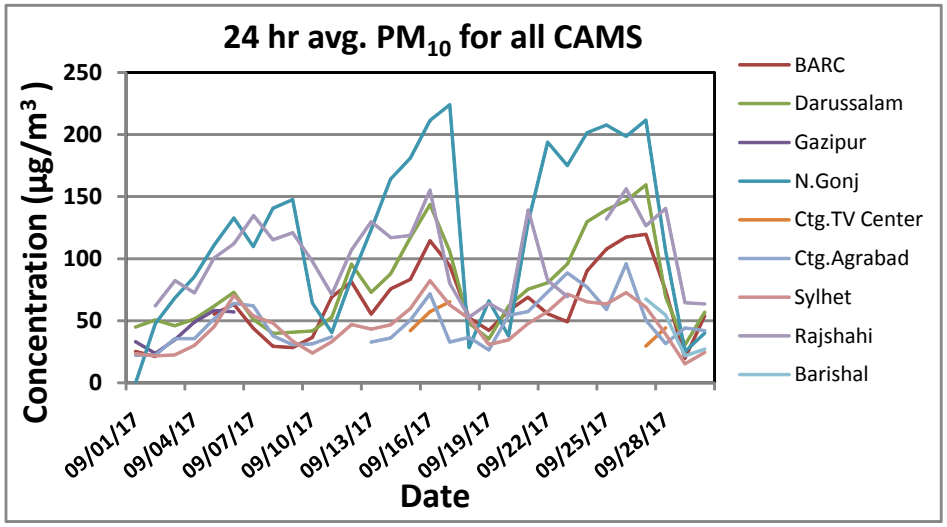


Figure 4: TIME SERIES OF ALL PARAMETERS (CO,PM10 AND PM2.5) MEASURED IN CAMS DURING September, 2017







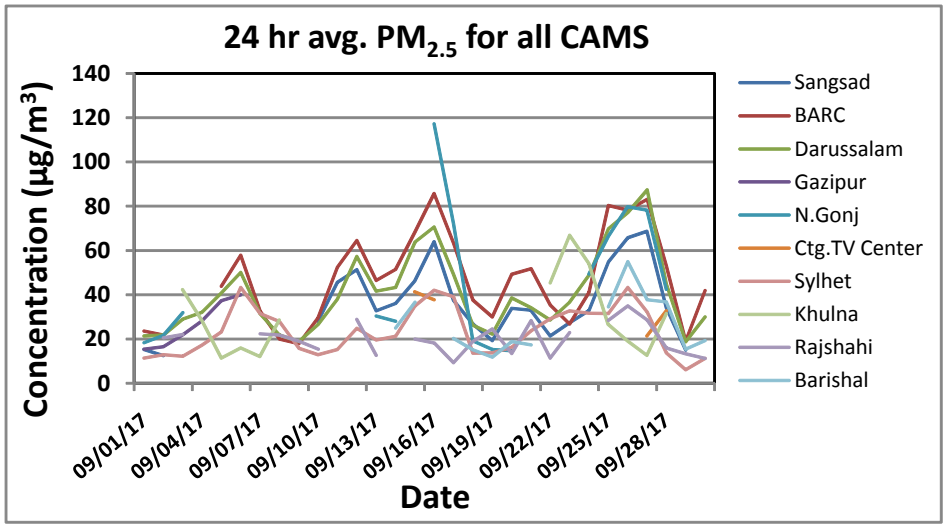


Figure 5: Monthly Summary of AQI for month of September, 2017