Government of the People's Republic of Bangladesh

Ministry of Environment and Forests

Monthly Air Quality Monitoring Report
Reporting Month: September, 2016

Clean Air and Sustainable Environment Project
(নির্মলবায়ুএবং টেকসইপরিবেশপ্রকল্প)

October, 2016

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).

The air quality index (AQI) is a number for reporting the state of air quality in an area on daily basis. In Bangladesh the AQI is based on 5 criteria pollutants; Particulate Matter (PM_{10} and $PM_{2.5}$), NO_2, CO, SO_2 and Ozone (O_3). AQI tells how clean or polluted the air is, and what associated health effects might be a concern for public. The AQI focuses on health effects that one might experience within a few hours or days after breathing polluted air. The AQI is a single number from 0 to 500 calculated on the basis of pollutant concentration measured in an area. Higher the AQI, higher is the air pollution level and thus indicates greater public health concern.

An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level that set by the mandated Environment Protection Agency (e.g., for Bangladesh Department of Environment) to protect public health. AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered to be unhealthy-at first for certain sensitive groups of people, then for everyone as AQI values get higher. The AQI standard for Bangladesh is given in Table 2.

Table 2: Air Quality Index (AQI) for Bangladesh

Air Quality Index (AQI) range	Category	Color
0-50	Good	Green
51-100	Moderate	Yellow Green
101-150	Caution	Yellow
151-200	Unhealthy	Orange
201-300	Very Unhealthy	Red
301-500	Extremely Unhealthy	Purple

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 3.

Table 3: 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.
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 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.

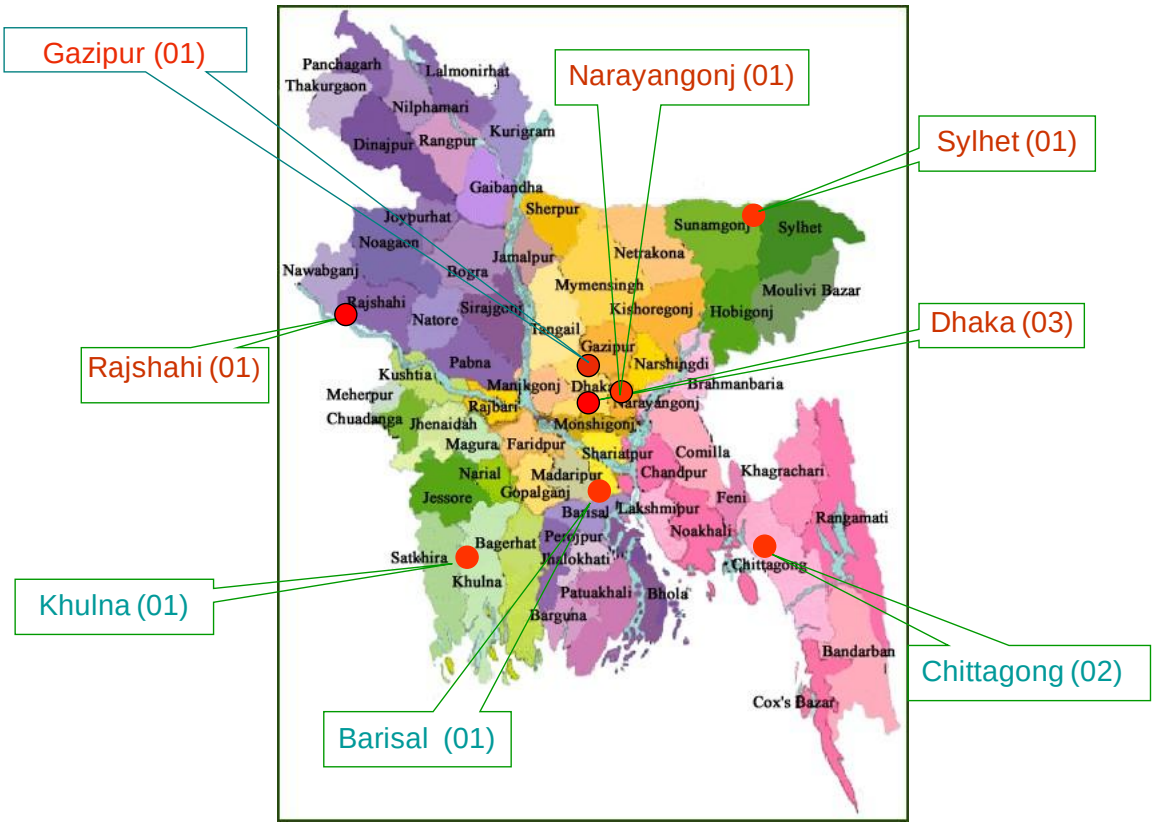


Figure 1: CAMS Location in Bangladesh

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 September, 2016 at 11 CAMS operated under CASE-DoE monitoring network. Table-4 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 Sangsad Bhaban CAMS, Khulna CAMS and TV station, Chittagong CAMS not included in the report due to nonfunctional of Data logger computer.

Inspection of the available data shows that there were no occurrences of non-compliance for PM10& PM2.5 levels at the monitoring stations except Narayonganj and Darussalam CAMS during the month of September, 2016. It is observed that the 24 hr average concentration level of PM2.5 and PM10 did not exceed BNAAQS. PM2.5 and PM10 results are not

reported in the month for TV Station Chittagong, Sangsad Bhaban, BARC, Farmgate CAMS and Khulna CAMS due to malfunction of PM Monitor and Data logger computer. The monthly average concentration level of PM2.5 and PM10 measured at different CAMS were found 21-33.6µg/m3 and 44-110.5µg/m^3 respectively during the month of September, 2016.That concentration level of those was found 21-31.6µg/m3 and 42.8-90.5µg/m^3 respectively during the month of August, 2016. From the time series plot of both PM10 and PM2.5, it is seen there are all episodes of PM concentrations is low. 24-hours average PM levels in all cities monitored are decreased compared to winter season because wind speed and precipitation is increased in rainy season. Higher wind speed increases dispersion and occurrences of rainfall helps washing out of particulate matter and thus decreases the PM pollution levels. It is also observed that all the gaseous pollutants except NOx measured at different CAMS did not exceed the BNAAQS during the month of September, 2016.

In general PM pollution levels in the cities monitored during the reporting month found lower. 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, 2016. It is observed that average wind speed and precipitation increases, which increase 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 (Table:2) are presented in annex Figure 5. Summary data shows majority of the days AQI values were in either moderate categories or good categories and few caution categories.

4. Summary and conclusion

Data obtained from CAMS operated under DoE air quality monitoring network during September, 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 lower. It is observed that the average concentration level of PM2.5 and PM10 measured at different CAMS were 21-33.6µg/m3 and 44-110.5µg/m^3 respectively during the month of September, 2016.
- The gaseous pollutants except NOx measured at different CAMS did not exceed limit values of the BNAAQS.
- Due to increasing average wind speed and precipitation during September, 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 the day's air quality was either Moderate or good categories 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.

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

ANNEX

Table 4: Summary Air Quality and Meteorological data measured during September, 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[1]	2.77	1.22	2.34	1.73	DNA[2]	1.47	DNA*	DNA[3]	4.76	0.81
			Max	DNA[1]	6.64	6.67	6.66	3.54	DNA[2]	5.39	DNA*	DNA[3]	8.59	1.75
			Min	DNA[1]	1.29	0.56	0.24	0.56	DNA[2]	0.24	DNA*	DNA[3]	1.72	0.43
			Excedance(Days)	DNA[1]	0	0	0	0	DNA[2]	0	DNA*	DNA[3]	0	0
			Data capture(%)	DNA[1]	85	87	64	44	DNA[2]	96	DNA*	DNA[3]	91	79
NO_2 -24 hr	ppb	53 (Annual)	Average	DNA[1]	DNA*	24.8	DNA*	15.7	DNA[2]	7.36	14.9	DNA[3]	28.3	7.82
			Max	DNA[1]	DNA*	71.5	DNA*	58.2	DNA[2]	14.3	25.4	DNA[3]	40.8	12.0
			Min	DNA[1]	DNA*	6.82	DNA*	5.81	DNA[2]	1.46	9.24	DNA[3]	19.32	6.27
			Excedance(Days)	DNA[1]	DNA*	1	DNA*	1	DNA[2]	0	0	DNA[3]	0	0
			Data capture(%)	DNA[1]	DNA*	92	DNA*	93	DNA[2]	76	93	DNA[3]	48	79
CO- 1 hr	ppm	35	Average	DNA[1]	1.02	1.71	1.43	DNA*	DNA[2]	1.17	1.58	DNA[3]	DNA*	0.74
			Max	DNA[1]	5.79	3.95	9.47	DNA*	DNA[2]	5.71	4.90	DNA[3]	DNA*	1.96
			Min	DNA[1]	0.05	1.15	0.42	DNA*	DNA[2]	0.05	1.03	DNA[3]	DNA*	0.46
			Excedance(Hour)	DNA[1]	0	0	0	DNA*	DNA[2]	0	0	DNA[3]	DNA*	0
			Data capture(%)	DNA[1]	88	96	85	DNA*	DNA[2]	95	93	DNA[3]	DNA*	79
CO-8hr	ppm	9	Average	DNA[1]	1.05	1.71	1.43	DNA*	DNA[2]	1.17	1.58	DNA[3]	DNA*	0.74
			Max	DNA[1]	3.78	3.01	6.37	DNA*	DNA[2]	2.13	3.09	DNA[3]	DNA*	1.70
			Min	DNA[1]	0.13	1.27	0.71	DNA*	DNA[2]	0.39	1.11	DNA[3]	DNA*	0.56
			Excedance(Hour)	DNA[1]	0	0	0	DNA*	DNA[2]	0	0	DNA[3]	DNA*	0
			Data capture(%)	DNA[1]	85	96	83	DNA*	DNA[2]	96	92	DNA[3]	DNA*	78
O_3-1hr	ppb	120	Average	DNA[1]	DNA*	2.11	DNA*	5.71	DNA[2]	10.7	8.39	DNA[3]	9.48	DNA*
			Max	DNA[1]	DNA*	16.0	DNA*	18.4	DNA[2]	42.3	33.0	DNA[3]	36.7	DNA*
			Min	DNA[1]	DNA*	0.43	DNA*	1.25	DNA[2]	0.07	0.05	DNA[3]	2.02	DNA*
			Excedance(Hour)	DNA[1]	DNA*	0	DNA*	0	DNA[2]	0	0	DNA[3]	0	DNA*
			Data capture(%)	DNA[1]	DNA*	95	DNA*	93	DNA[2]	94	83	DNA[3]	94	DNA*
O_3-8hr	ppb	80	Average	DNA[1]	DNA*	2.12	DNA*	5.78	DNA[2]	10.7	8.65	DNA[3]	9.52	DNA*
			Max	DNA[1]	DNA*	7.76	DNA*	15.7	DNA[2]	24.6	26.0	DNA[3]	18.2	DNA*
			Min	DNA[1]	DNA*	0.78	DNA*	1.39	DNA[2]	2.08	0.54	DNA[3]	2.83	DNA*
			Excedance(Hour)	DNA[1]	DNA*	0	DNA*	0	DNA[2]	0	0	DNA[3]	0	DNA*
			Data capture(%)	DNA[1]	DNA*	94	DNA*	94	DNA[2]	94	79	DNA[3]	93	DNA*

CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, a=Refurbisment CAMS, PM= Particulate Matter
DNA= Data Not Available, 1,2&3= DNA due to station/ station Data logger not in operation, *=DNA due to malfunction of the analyzer/sensor/ poor data capture rate

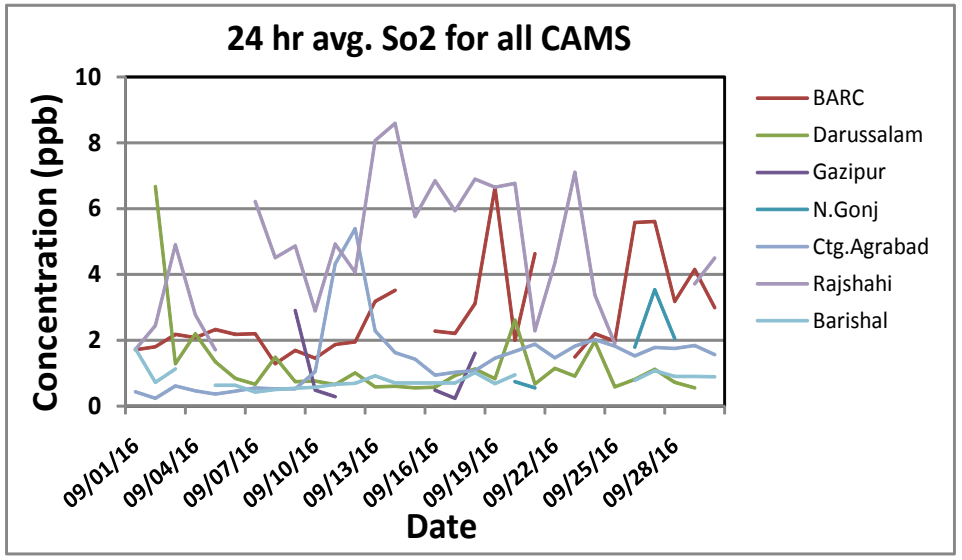
Table 4: Summary Air Quality and Meteorological data measured during September, 2016 at different CAMS operated under DoE (Cont'd)

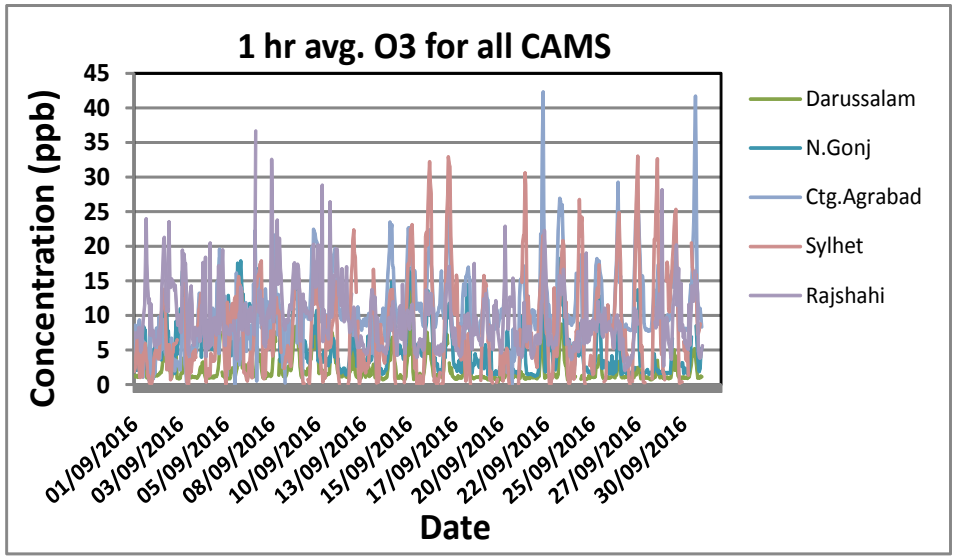
Parameter	unit	NAAQS	Summary	CAMS-1 (S-Bhaban)	CAMS-2 (BARC)[a]	CAMS-3 (D-salam)	CAMS-4 (Gazipur)	CAMS-5 (Narayonganj)	CAMS-6 TV-St (Chittagong)[a]	CAMS-7 Agrabad-(Chittagong)	CAMS-8 (Sylhet)	CAMS-9 (Khulna)[a]	CAMS-10 (Rajshahi)[a]	CAMS-11 (Barisal)
$PM_{2.5}$ -24hr	µg /m^3	65	Average	DNA[1]	DNA*	32.7	25.1	25.3	DNA[2]	21.0	23.4	DNA[3]	23.5	28.9
			Max	DNA[1]	DNA*	71.8	40.7	58.3	DNA[2]	34.4	37.2	DNA[3]	36	41.2
			Min	DNA[1]	DNA*	17.5	14.5	13.2	DNA[2]	12.6	13.3	DNA[3]	13.2	19.9
			Excedance(Days)	DNA[1]	DNA*	1	0	0	DNA[2]	0	0	DNA[3]	0	0
			Data capture(%)	DNA[1]	DNA*	82	73	83	DNA[2]	95	72	DNA[3]	79	72
PM_{10} -24hr	µg /m^3	150	Average	DNA[1]	DNA*	62.6	45.0	110	DNA[2]	44.8	46.3	DNA[3]	53.6	47.4
			Max	DNA[1]	DNA*	123	123	252	DNA[2]	86.7	82.6	DNA[3]	83.3	64.9
			Min	DNA[1]	DNA*	35.8	26.7	39.1	DNA[2]	26.9	27.4	DNA[3]	30.7	26.3
			Excedance(Days)	DNA[1]	DNA*	0	0	4	DNA[2]	0	0	DNA[3]	0	0
			Data capture(%)	DNA[1]	DNA*	73	74	89	DNA[2]	87	83	DNA[3]	91	73
Solar rad. 1hr	watt/m^2	NA	Average	DNA[1]	DNA*	168	171	DNA*	DNA[2]	199	182	DNA[3]	DNA*	176
			Max	DNA[1]	DNA*	980	997	DNA*	DNA[2]	938	924	DNA[3]	DNA*	957
			Min	DNA[1]	DNA*	7.35	6.71	DNA*	DNA[2]	6.90	5.76	DNA[3]	DNA*	8.08
			Data capture(%)	DNA[1]	DNA*	96	83	DNA*	DNA[2]	95	93	DNA[3]	DNA*	79
Relative Humidity 1hr	(%)	NA	Average	DNA[1]	83.5	77.9	92.7	79.3	DNA[2]	78.0	82.7	DNA[3]	80.5	83.2
			Max	DNA[1]	96.8	90.7	99.5	91.0	DNA[2]	93.5	97.8	DNA[3]	85.9	99.2
			Min	DNA[1]	54.0	49.7	54.9	52.2	DNA[2]	51.8	57.4	DNA[3]	77.5	55.1
			Data capture(%)	DNA[1]	97	96	83	93	DNA[2]	95	93	DNA[3]	94	79
Ambient Temp. 1hr	(°c)	NA	Average	DNA[1]	26.5	29.4	28.4	DNA*	DNA[2]	28.5	28.5	DNA[3]	32.9	30.1
			Max	DNA[1]	31.4	34.7	33.9	DNA*	DNA[2]	33.8	33.6	DNA[3]	35.9	35.8
			Min	DNA[1]	26.0	25.8	24.7	DNA*	DNA[2]	24.7	23.6	DNA[3]	31.2	25.5
			Data capture(%)	DNA[1]	97	96	83	DNA*	DNA[2]	95	93	DNA[3]	94	79
Rainfall 1hr	(m.m.)	NA	Average	DNA[1]	1.44	0.28	0.42	0.27	DNA[2]	0.42	0.28	DNA[3]	DNA*	DNA*
			Max	DNA[1]	5.36	5.83	20.7	0.72	DNA[2]	99.2	5.67	DNA[3]	DNA*	DNA*
			Min	DNA[1]	0.03	0.02	0.02	0.06	DNA[2]	0.02	0.02	DNA[3]	DNA*	DNA*
			Data capture(%)	DNA[1]	83	28	41	93	DNA[2]	89	53	DNA[3]	DNA*	DNA*

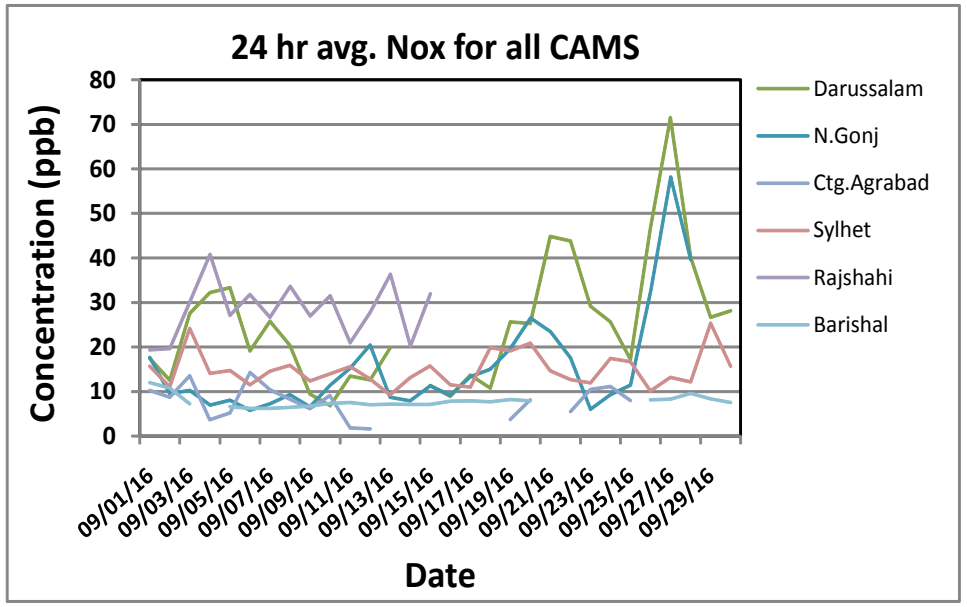
CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, a=Refurbisment CAMS, PM= Particulate Matter

DNA= Data Not Available, 1,2&3= DNA due to station/ station Data logger not in operation, *=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 SEPTEMBER, 2016







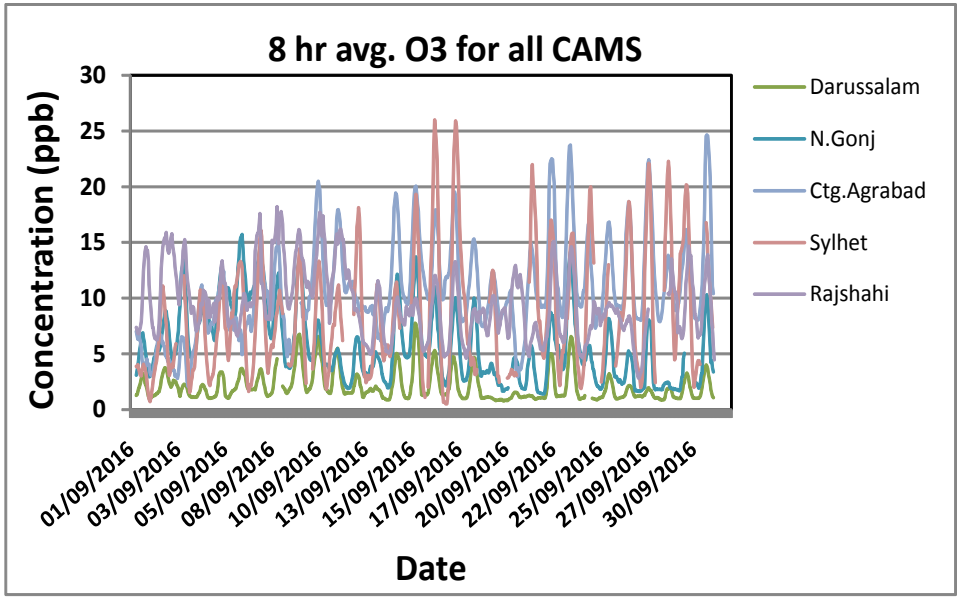
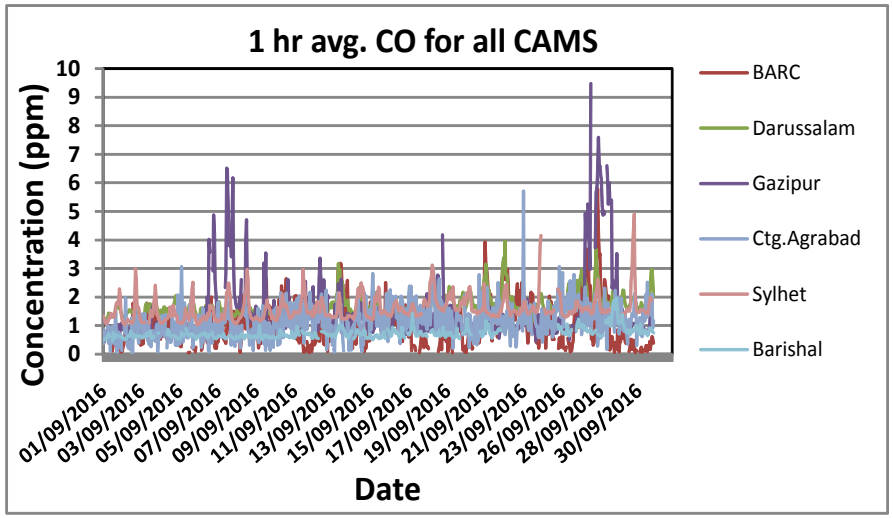
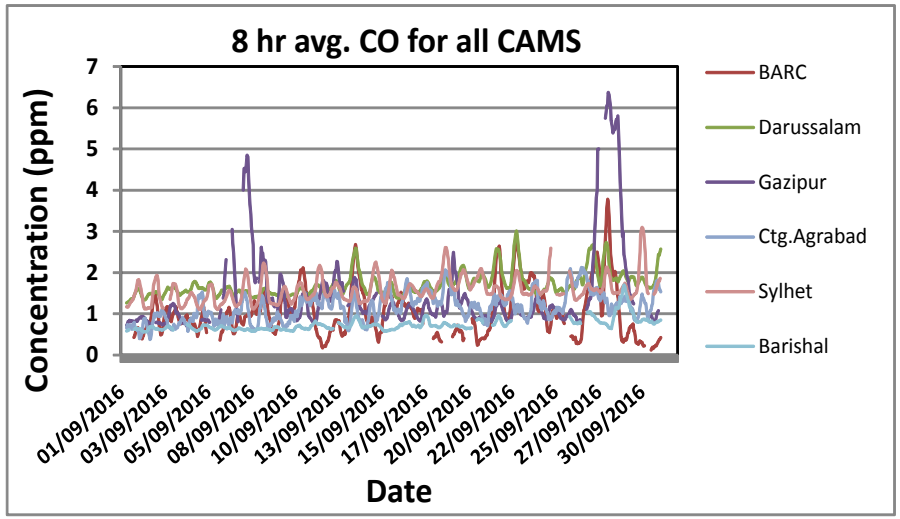
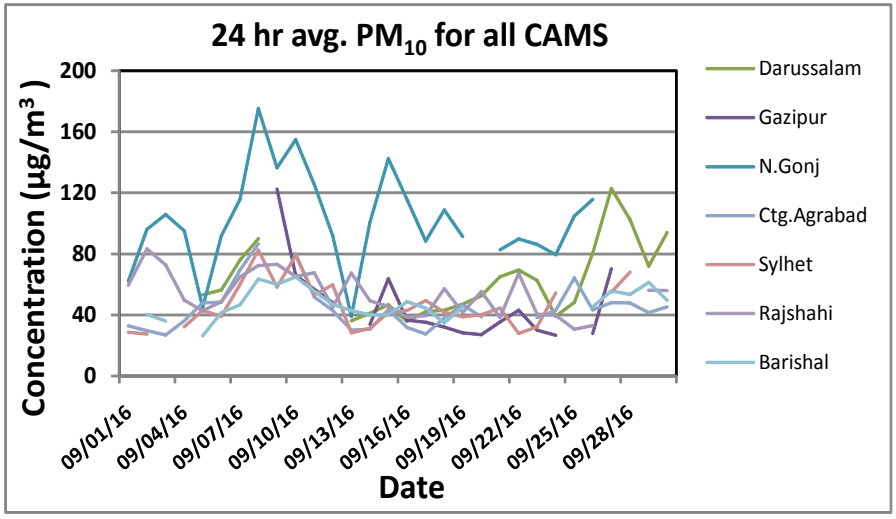


Figure 4: TIME SERIES OF ALL PARAMETERS (CO, PM10 AND PM2.5) MEASURED IN CAMS DURING SEPTEMBER, 2016







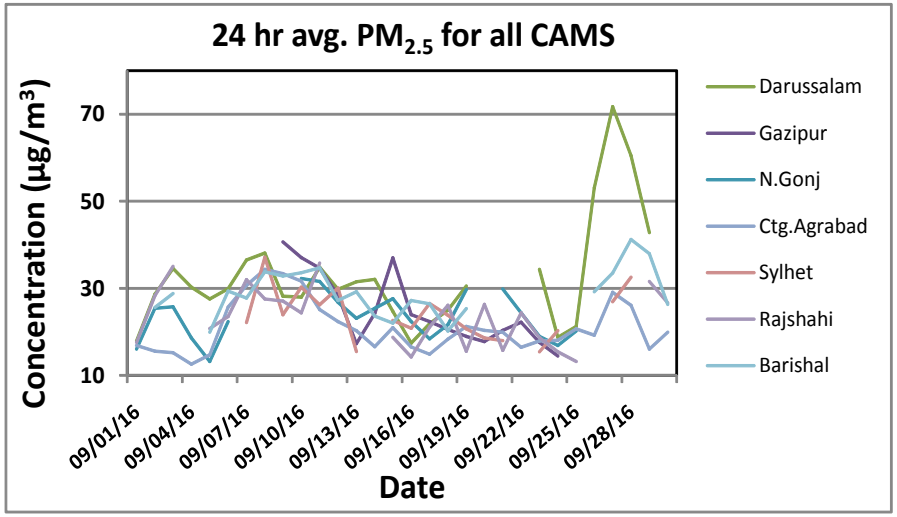


Figure 5: Monthly Summary of AQI for month of September, 2016