Government of the People's Republic of Bangladesh

Ministry of Environment and Forests

Monthly Air Quality Monitoring Report
Reporting Month: September, 2018

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

October, 2018

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 August 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.

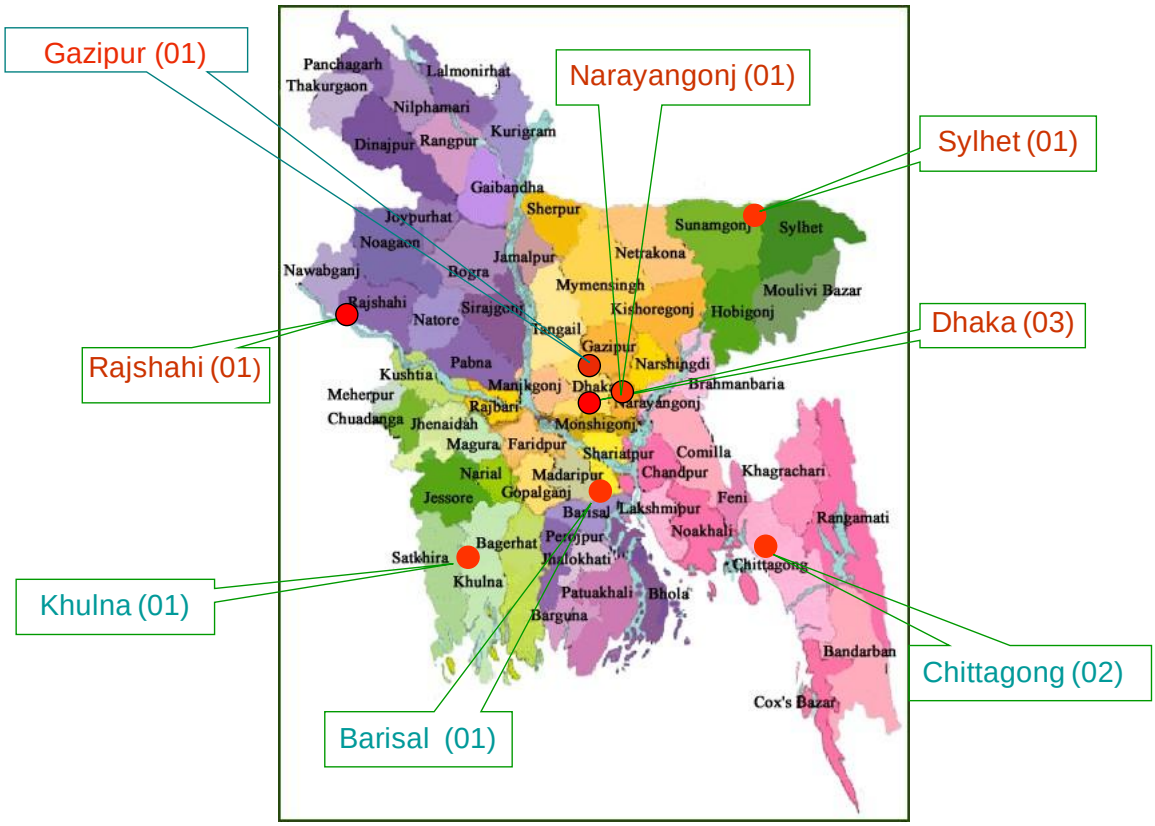


Figure 1: CAMS Location in Bangladesh

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, 2018 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 were not functional for some days 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, 2018. It is observed that the 24 hr average concentration level of PM2.5 exceeded BNAAQS for 11 days in BARC CAMS, 4-5 days in Darussalam CAMS and Narayonganj CAMS, 1-2 days in Rajshahi & Barishal CAMS, while the values were within the limit of BNAAQS in terms of other monitoring stations. On the other hand, 24 hr average concentration level of PM10 from the BNAAQS exceeded for 11 days in Narayanganj and Agrabad, Chittagong CAMS, 3-4 days in Darussalam and Rajshahi CAMS. The range of monthly average concentration of PM2.5 and PM10 measured at different CAMS were 23-57 µg/m3 and 44-151 µg/m^3 respectively during the monitoring month of September, 2018. From BNAAQS point of view, concentrations of PM cross their standards in very few days (Fig-3). 24-hours average PM levels in all cities demonstrate increasing trends compared to August 2018 due to decreasing trend of precipitation. It is also observed that gaseous pollutants measured at different CAMS did not exceed the BNAAQS during the month of September, 2018.

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 compare to the wet season, which is reflected in the data monitored in all CAMS during the month of September, 2018.

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 that AQI values were Good to Caution along with unhealthy in couple of CAMS.

4. Summary and conclusion

Data obtained from CAMS operated under DoE air quality monitoring network during September, 2018 have been analyzed and reported. Data availability was 60-90% for all the criteria pollutants monitored at different CAMS with few exceptions. Air quality data for few 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. From BNAAQS point of view, 24-hour average for both PM10 and PM2.5 concentrations were found slightly higher than the month of August, 2018 with few exceptions. It is observed that the average concentration level of PM2.5 and PM10 measured at different CAMS were 5-120 µg/m^3 and 15-271 µg/m^3 respectively during the monitoring month of September, 2018
- The gaseous pollutants measured at different CAMS did not exceed limit values of the BNAAQS.
- Due to decreasing tendency of precipitation during September, 2018, the pollution concentration levels was slightly higher than the previous month although there was no remarkable variation of average wind speed.
- Monthly summary of calculated AQI values based on data from different CAMS showed that during this month most of day's air quality was in all categories with the majority of Good to Caution along with unhealthy in couple of CAMS and in most of the cases responsible pollutant was PM2.5.

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

Table 3: Summary Air Quality and Meteorological data measured during September, 2018 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	0.45	DNA	4.34	DNA	DNA	DNA	DNA	6.34	0.35
			Max	DNA	DNA	0.80	DNA	10.4	DNA	DNA	DNA	DNA	40.2	0.58
			Min	DNA	DNA	0.24	DNA	0.51	DNA	DNA	DNA	DNA	0.61	0.15
			Excedance(Days)	DNA	DNA	0	DNA	0	DNA	DNA	DNA	DNA	0	0
			Data capture(%)	DNA	DNA	77	DNA	87	DNA	9	0	5	54	81
NO_2 -24 hr	ppb	53 (Annual)	Average	DNA	32.1	20.7	13.9	19.6	DNA	14.5	11.7	9.05	54.0	4.28
			Max	DNA	87.6	39.2	41.7	46.0	DNA	19.6	14.7	11.7	113	6.81
			Min	DNA	8.37	11.6	0.81	1.55	DNA	7.84	8.84	7.09	20.03	2.58
			Excedance(Days)	DNA	0	0	0	0	DNA	0	0	0	0	0
			Data capture(%)	DNA	91	97	66	93	DNA	32	95	13	38	97
CO- 1 hr	ppm	35	Average	DNA	0.21	DNA	DNA	0.91	DNA	0.32	DNA	0.60	0.83	0.80
			Max	DNA	0.88	DNA	DNA	2.13	DNA	8.06	DNA	12.5	2.58	1.70
			Min	DNA	0.05	DNA	DNA	0.44	DNA	0.05	DNA	0.05	0.05	0.43
			Excedance(Hour)	DNA	0	DNA	DNA	0	DNA	0	DNA	0	0	0
			Data capture(%)	DNA	30	DNA	DNA	93	DNA	62	DNA	27	83	97
CO-8hr	ppm	9	Average	DNA	0.26	DNA	DNA	0.90	DNA	0.32	DNA	0.61	0.84	0.80
			Max	DNA	0.80	DNA	DNA	1.77	DNA	1.95	DNA	2.60	2.13	1.47
			Min	DNA	0.06	DNA	DNA	0.47	DNA	0.07	DNA	0.19	0.09	0.46
			Excedance(Hour)	DNA	0	DNA	DNA	0	DNA	0	DNA	0	0	0
			Data capture(%)	DNA	20	DNA	DNA	91	DNA	57	DNA	23	78	96
O_3-1hr	ppb	120	Average	DNA	3.18	DNA	4.23	2.56	DNA	10.3	5.34	4.27	DNA	11.24
			Max	DNA	21.8	DNA	39.1	13.0	DNA	32.9	15.8	29.6	DNA	25.1
			Min	DNA	0.82	DNA	0.23	0.42	DNA	4.75	1.60	0.05	DNA	3.05
			Excedance(Hour)	DNA	0	DNA	0	0	DNA	0	0	0	DNA	0
			Data capture(%)	DNA	92	DNA	92	93	DNA	33	51	36	DNA	53
O_3-8hr	ppb	80	Average	DNA	3.19	DNA	4.27	2.56	DNA	10.3	5.34	4.43	DNA	11.3
			Max	DNA	9.53	DNA	23.0	10.4	DNA	27.5	13.3	25.9	DNA	20.4
			Min	DNA	1.12	DNA	0.55	0.52	DNA	5.70	2.27	0.60	DNA	3.92
			Excedance(Hour)	DNA	0	DNA	0	0	DNA	0	0	0	DNA	0
			Data capture(%)	DNA	91	DNA	89	91	DNA	33	49	33	DNA	52

CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, a=Refurbisment CAMS, PM= Particulate Matter
DNA= Data Not Available

ANNEX

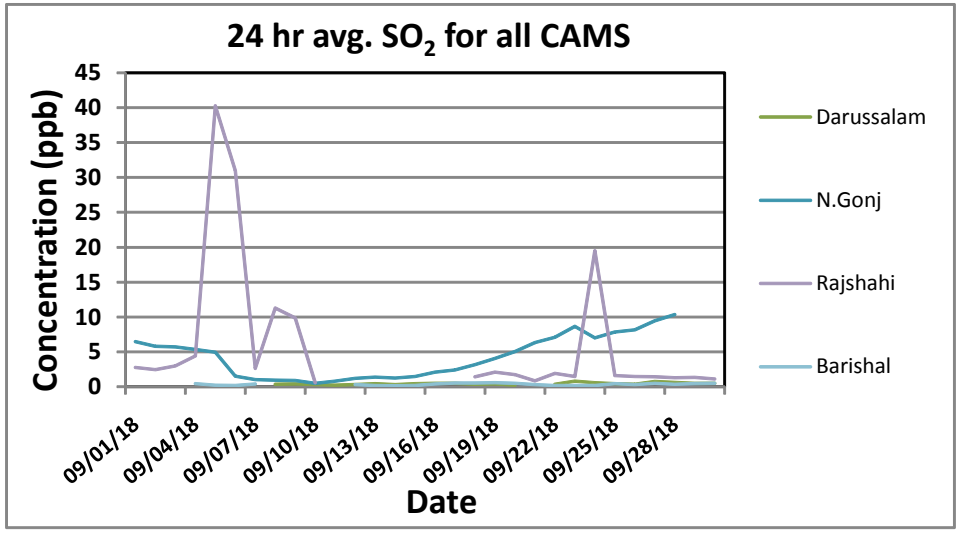
Table 3: Summary Air Quality and Meteorological data measured during September, 2018 at different CAMS operated under DoE (Cont'd)

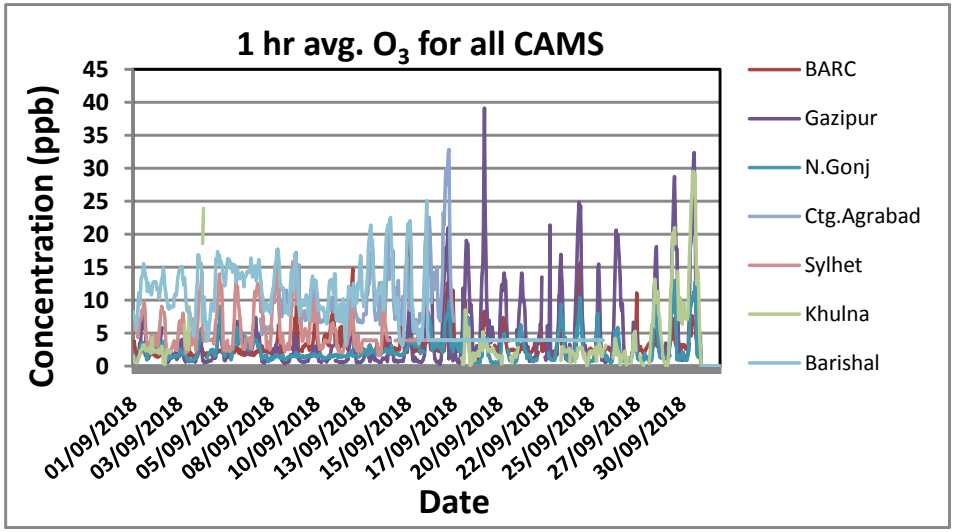
Parameter	unit	NAAQS	Summary	CAMS-1 (S-Bhaban)	CAMS-2 (BARC)[a]	CAMS-3 (D-salam)	CAMS-4 (Gazipur)	CAMS-5 (Narayonganj)	CAMS-6 TV-St (Chittagong)[a]	CAMS-7 Agrabad-(Chittagong)	CAMS-8 (Sylhet)	CAMS-9 (Khulna)[a]	CAMS-10 (Rajshahi)[a]	CAMS-11 (Barisal)
$PM_{2.5}$ -24hr	µg /m^3	65	Average	DNA	56.6	45.6	DNA	37.6	DNA	DNA	27.9	22.7	38.8	30.2
			Max	DNA	120	95.0	DNA	91.1	DNA	DNA	55.3	47.8	67.6	65.4
			Min	DNA	23.8	14.0	DNA	8.88	DNA	DNA	6.99	5.18	5.65	7.54
			Excedance(Days)	DNA	11	4	DNA	5	DNA	DNA	0	0	2	1
			Data capture(%)	DNA	91	95	DNA	62	DNA	DNA	87	42	86	93
PM_{10} -24hr	µg /m^3	150	Average	DNA	80.7	103	85.6	151	DNA	128	60.7	44.4	99.4	59.0
			Max	DNA	158	189	215	271	DNA	242	105	83.3	176	142
			Min	DNA	38.9	40.7	25.1	69.1	DNA	38.0	26.9	15.1	35.7	18.1
			Excedance(Days)	DNA	1	3	2	11	DNA	11	0	0	4	0
			Data capture(%)	DNA	83	61	89	86	DNA	97	94	41	87	82
Solar rad. 1hr	watt/m^2	NA	Average	DNA	DNA	197	DNA	DNA	DNA	192	169	DNA	DNA	179
			Max	DNA	DNA	999	DNA	DNA	DNA	910	955	DNA	DNA	911
			Min	DNA	DNA	6.77	DNA	DNA	DNA	6.54	5.11	DNA	DNA	7.93
			Data capture(%)	DNA	DNA	96	DNA	DNA	DNA	96	96	DNA	DNA	97
Relative Humidity 1hr	(%)	NA	Average	DNA	DNA	73.7	DNA	DNA	DNA	77.6	83.3	65.5	DNA	81.7
			Max	DNA	DNA	90.6	DNA	DNA	DNA	92.8	98.2	89.7	DNA	97.6
			Min	DNA	DNA	48.4	DNA	DNA	DNA	45.0	53.1	31.3	DNA	47.4
			Data capture(%)	DNA	DNA	97	DNA	DNA	DNA	96	96	11	DNA	97
Ambient Temp. 1hr	(°c)	NA	Average	DNA	DNA	30.5	DNA	DNA	DNA	26.1	28.5	DNA	DNA	30.6
			Max	DNA	DNA	37.5	DNA	DNA	DNA	34.2	35.5	DNA	DNA	38.6
			Min	DNA	DNA	25.6	DNA	DNA	DNA	24.3	23.0	DNA	DNA	26.3
			Data capture(%)	DNA	DNA	97	DNA	DNA	DNA	97	96	DNA	DNA	97
Rainfall 1hr	(m.m.)	NA	Average	DNA	0.71	0.08	1.72	DNA	DNA	2.83	0.31	1.10	7.87	DNA
			Max	DNA	5.75	1.42	3.52	DNA	DNA	3.59	9.28	2.86	18.59	DNA
			Min	DNA	0.02	0.02	0.10	DNA	DNA	2.77	0.02	0.25	0.43	DNA
			Data capture(%)	DNA	2	47	92	DNA	DNA	8	57	11	3	DNA

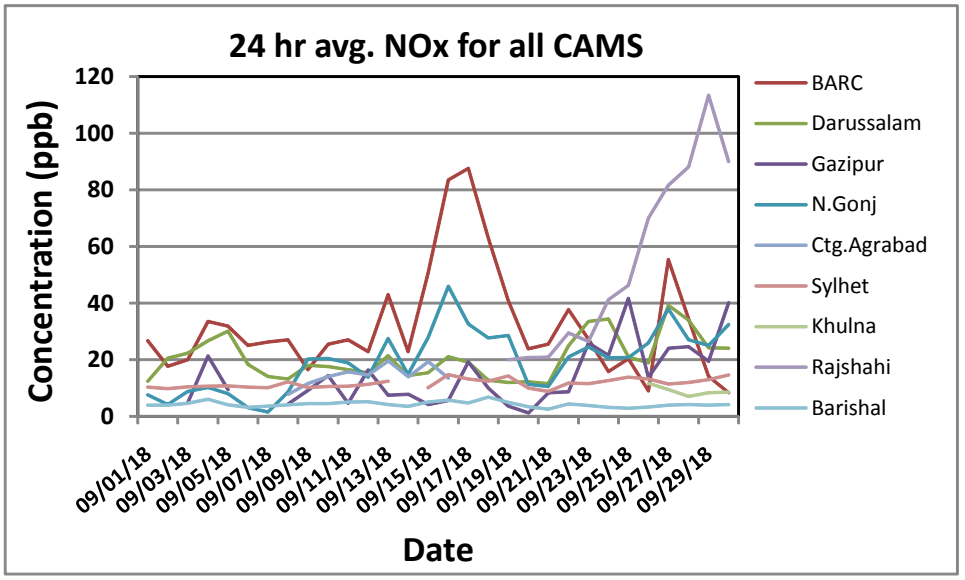
CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, a=Refurbisment CAMS, PM= Particulate Matter

DNA= Data Not Available

FIGURE 2: TIME SERIES OF ALL PARAMETERS (SO_2, NOx AND O_3) MEASURED IN ALL CAMS DURING SEPTEMBER, 2018







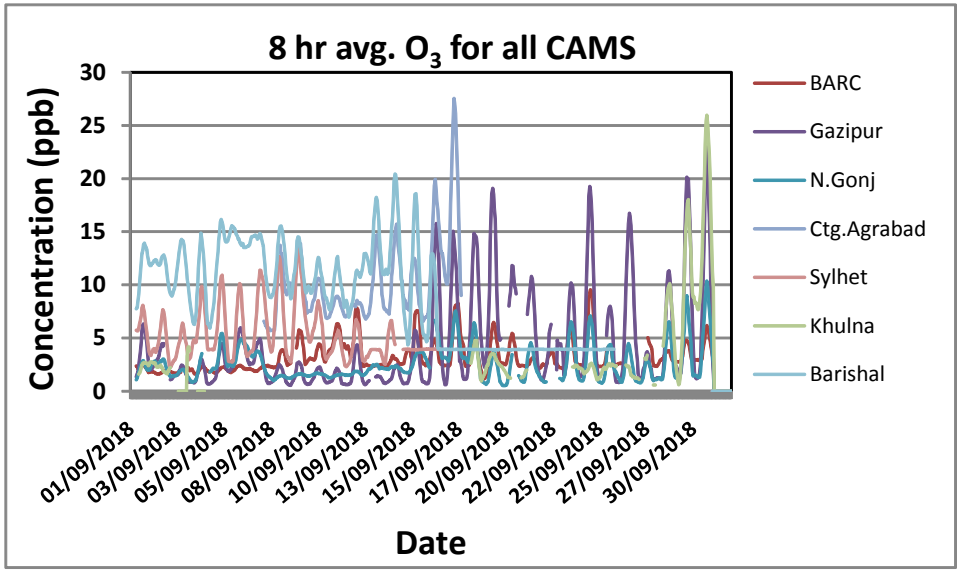
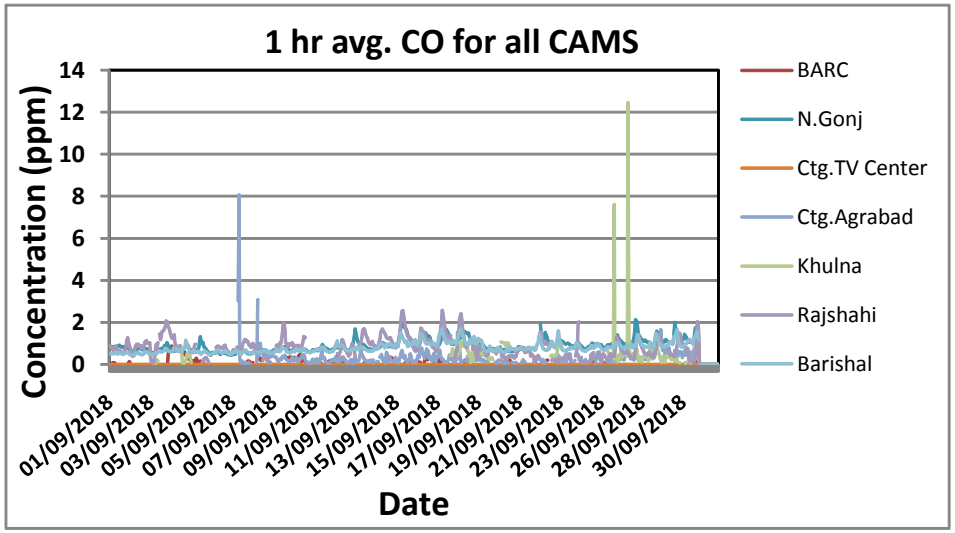
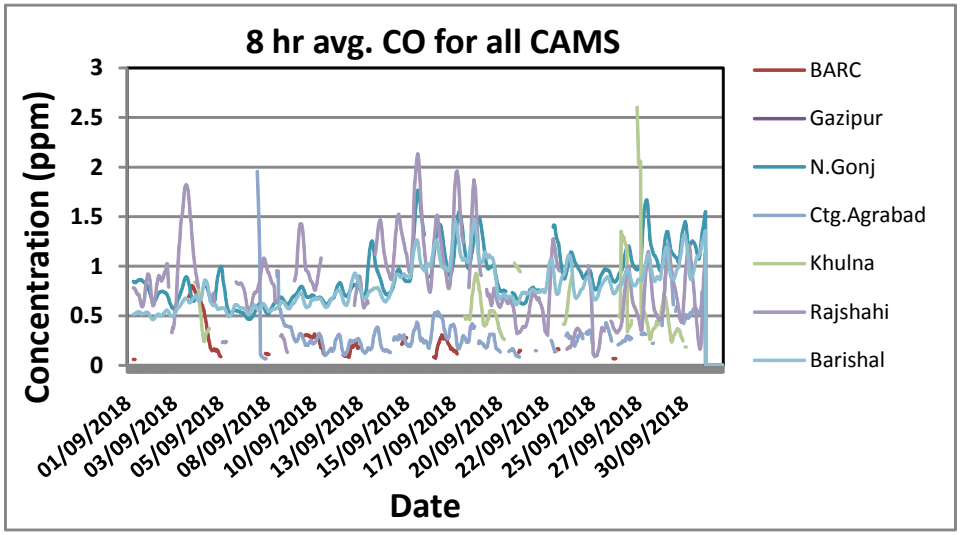
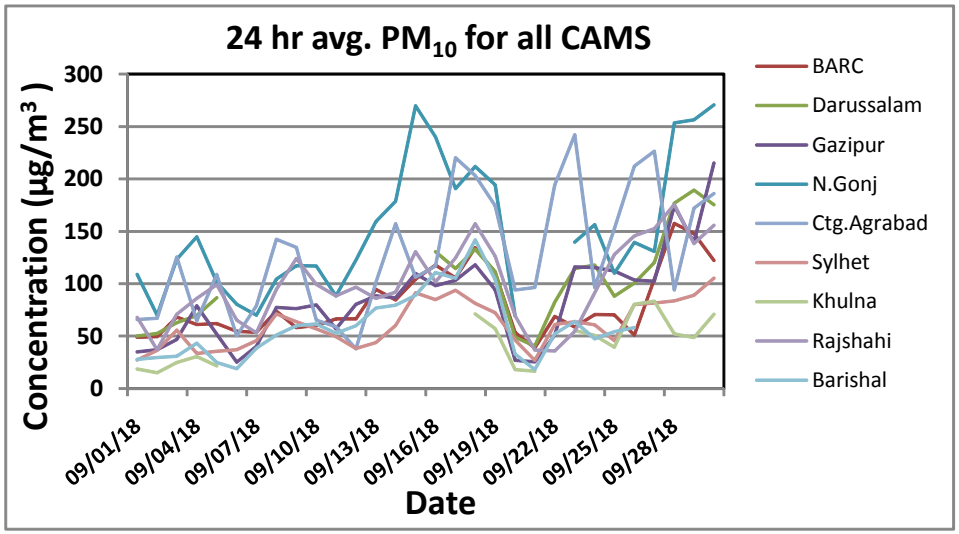


FIGURE 3: TIME SERIES OF ALL PARAMETERS (CO,PM10 AND PM2.5) MEASURED IN CAMS DURING SEPTEMBER, 2018







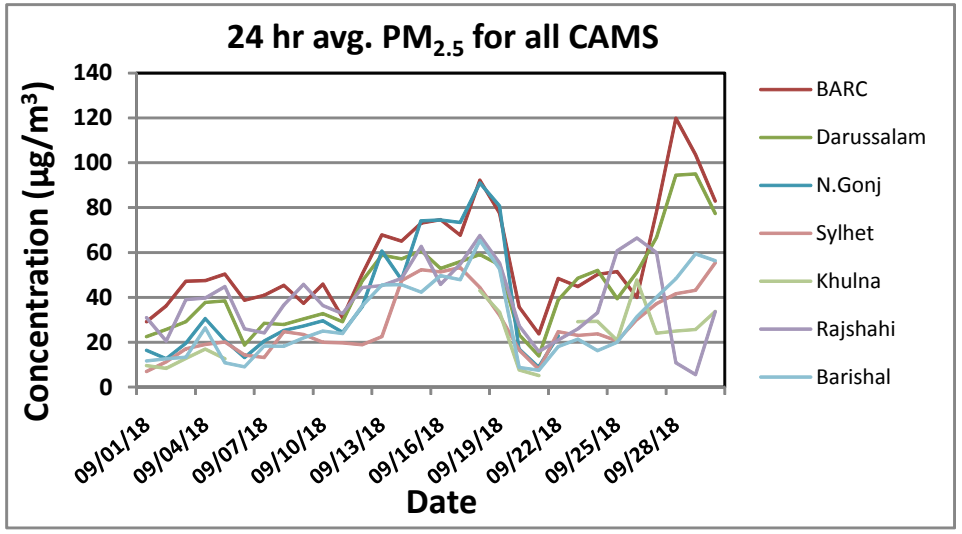


Figure 4: Monthly Summary of AQI for month of September, 2018