Government of the People's Republic of Bangladesh

Ministry of Environment and Forests

Monthly Air Quality Monitoring Report
Reporting Month: January, 2018

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

February, 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 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	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	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.

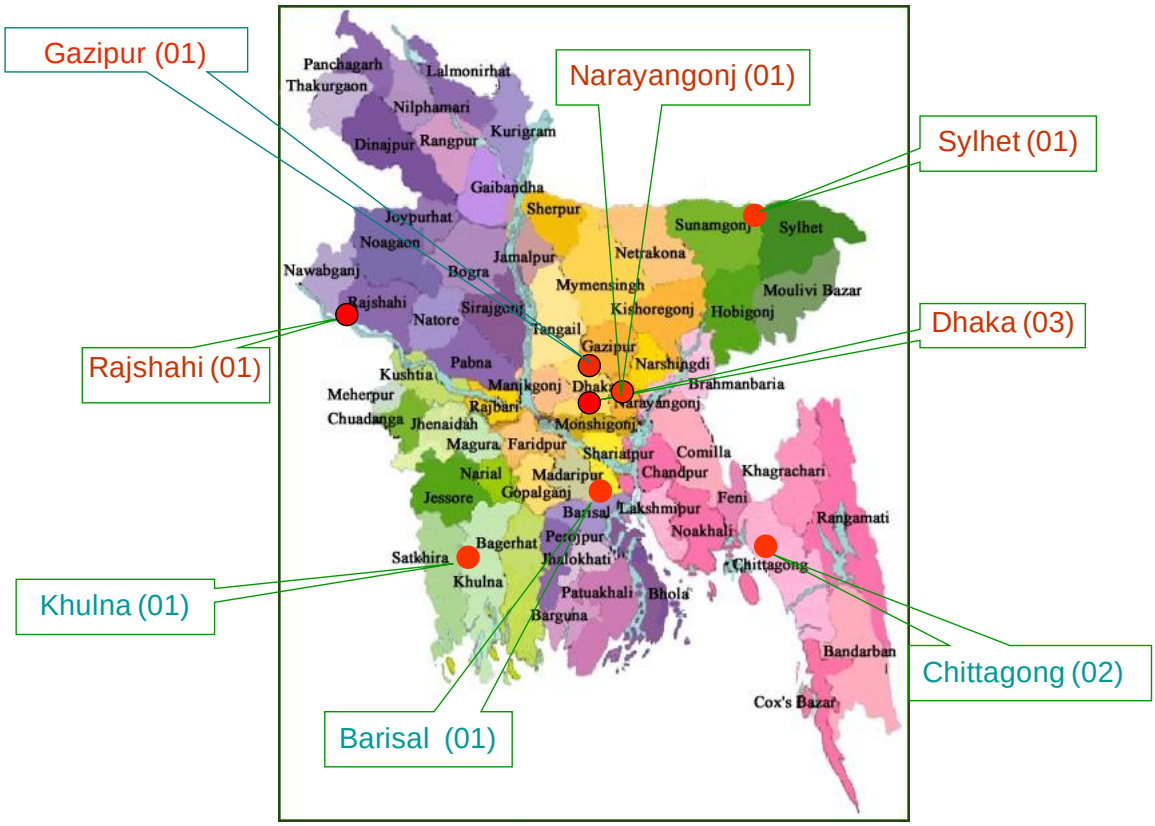


Figure 1: CAMS Location in Bangladesh

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 January, 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 occurrences of non-compliance for PM10& PM2.5 levels at all monitoring stations during the month of January, 2018. It is observed that the 24 hr average concentration level of PM2.5 exceeded BNAAQS for 30 days in BARC, 27 days in Narayanganj, 31 days in D.salam and Gazipur, 29 days in Khulna and Rajshahi, 24 days in TV station, Ctg and 21 days at Shylet CAMS during the month of January, 2018. For PM10 non-attainment with respect to BNAAQS occurred for 31 days at Narayanganj, D.Salam, Gazipur and Barishal CAMS, 10 days in Rajshahi, 28 days in BARC, 23 days in TV station and 30 days in Agrabad, Ctg, 27 days in Sylhet, CAMS during the reporting month. The monthly average concentration level of PM2.5 and PM10 measured at different CAMS were found 93-259 µg/m3 and 185-428 µg/m^3 respectively during the monitoring month of January, 2018. The concentration level of those was found 56-224 µg/m3 and 117-396 µg/m^3 respectively during the month of December, 2017. From the time series plot of both PM10 and PM2.5, it is seen in most cases PM concentrations greater than the BNAAQS. 24-hours average PM levels in all cities monitored are increasing compared to previous month because of decreasing average wind speed and lower precipitation along with some other emission situations. It is also observed that gaseous pollutants measured at different CAMS did not exceed the BNAAQS during the month of January, 2018.

In general PM pollution levels in the cities monitored during the reporting month found 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 January, 2018. It is observed that average wind speed and precipitation compared to previous month has a decreasing tendency, which decreases the rate of dispersion of the pollutants and this might be a reason for observed higher 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 all categories with the majority of Very Unhealthy to Extremely Unhealthy.

4. Summary and conclusion

Data obtained from CAMS operated under DoE air quality monitoring network during January, 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. 24-hour average for both PM10 and PM2.5 concentrations were found higher than the BNAAQS during the month of January, 2018 with few exceptions. It is observed that the average concentration level of PM2.5 and PM10 measured at different CAMS were 93-259 µg/m3 and 185-428 µg/m^3 respectively during the monitoring month of January, 2018.
- The gaseous pollutants measured at different CAMS did not exceed the BNAAQS.
- Due to decreasing average wind speed and lower precipitation during January, 2018, the PM pollution concentration levels showed higher than the previous month.

- 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 Very unhealthy to extremely Unhealthy and in all cases most frequent responsible pollutant was PM2.5.

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 January, 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	31.7	14.8	1.42	19.9	DNA	DNA	DNA	DNA	2.07	5.62
			Max	DNA	48.1	21.2	4.80	44.2	DNA	DNA	DNA	DNA	4.68	8.05
			Min	DNA	11.9	9.42	0.26	1.64	DNA	DNA	DNA	DNA	0.97	3.89
			Excedance(Days)	DNA	0	0	0	0	DNA	DNA	DNA	DNA	0	0
			Data capture(%)	DNA	81	95	87	87	DNA	DNA	DNA	DNA	80	93
NO_2 -24 hr	ppb	53 (Annual)	Average	DNA	DNA	DNA	45.1	85.4	27.4	52.3	19.2	61.4	DNA	42.9
			Max	DNA	DNA	DNA	76.6	163	61.1	118	38.4	101	DNA	88.5
			Min	DNA	DNA	DNA	16.8	37.0	10.4	31.7	9.78	37.3	DNA	22.9
			Excedance(Days)	DNA	DNA	DNA	0	0	0	0	0	0	DNA	0
			Data capture(%)	DNA	DNA	DNA	93	97	85	81	96	63	DNA	94
CO- 1 hr	ppm	35	Average	DNA	1.11	DNA	DNA	DNA	1.04	DNA	DNA	1.32	1.47	DNA
			Max	DNA	6.07	DNA	DNA	DNA	3.13	DNA	DNA	10.1	6.03	DNA
			Min	DNA	0.05	DNA	DNA	DNA	0.23	DNA	DNA	0.05	0.07	DNA
			Excedance(Hour)	DNA	0	DNA	DNA	DNA	0	DNA	DNA	0	0	DNA
			Data capture(%)	DNA	66	DNA	DNA	DNA	81	DNA	DNA	76	86	DNA
CO-8hr	ppm	9	Average	DNA	1.16	DNA	DNA	DNA	1.04	DNA	DNA	1.32	1.47	DNA
			Max	DNA	3.40	DNA	DNA	DNA	2.54	DNA	DNA	4.06	3.69	DNA
			Min	DNA	0.13	DNA	DNA	DNA	0.34	DNA	DNA	0.08	0.49	DNA
			Excedance(Hour)	DNA	0	DNA	DNA	DNA	0	DNA	DNA	0	0	DNA
			Data capture(%)	DNA	58	DNA	DNA	DNA	79	DNA	DNA	74	83	DNA
O_3-1hr	ppb	120	Average	DNA	2.46	4.09	DNA	2.95	4.51	DNA	DNA	8.59	DNA	20.1
			Max	DNA	11.3	23.9	DNA	14.7	13.8	DNA	DNA	39.4	DNA	69.0
			Min	DNA	0.06	0.36	DNA	0.13	1.17	DNA	DNA	0.05	DNA	1.43
			Excedance(Hour)	DNA	0	0	DNA	0	0	DNA	DNA	0	DNA	0
			Data capture(%)	DNA	85	39	DNA	97	85	DNA	DNA	81	DNA	94
O_3-8hr	ppb	80	Average	DNA	2.45	3.98	DNA	2.97	4.51	DNA	DNA	8.88	DNA	20.5
			Max	DNA	6.99	18.6	DNA	9.57	8.39	DNA	DNA	27.6	DNA	57.6
			Min	DNA	0.21	0.44	DNA	0.17	2.08	DNA	DNA	0.10	DNA	3.66
			Excedance(Hour)	DNA	0	0	DNA	0	0	DNA	DNA	0	DNA	0
			Data capture(%)	DNA	86	37	DNA	97	83	DNA	DNA	76	DNA	92

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

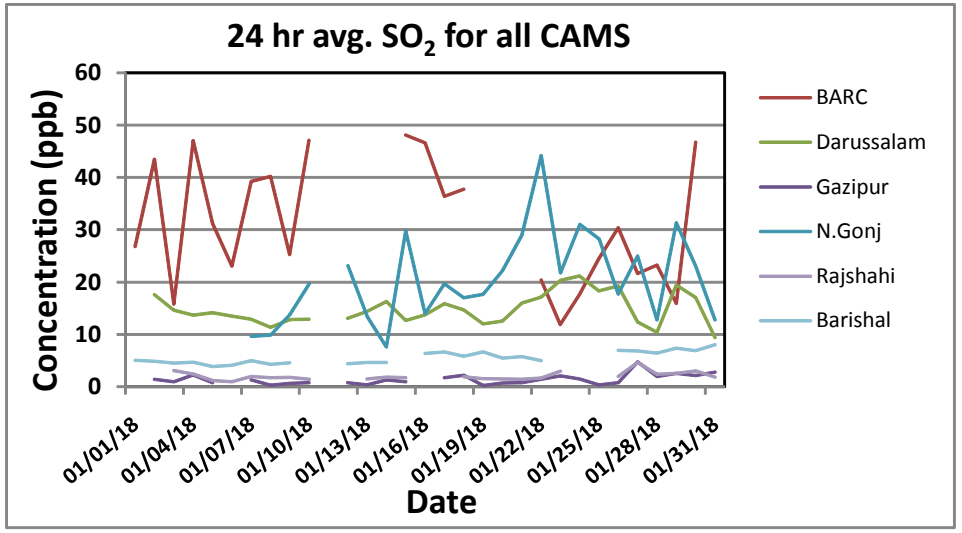
Table 3: Summary Air Quality and Meteorological data measured during January, 2018 at different CAMS operated under DoE (Cont'd)

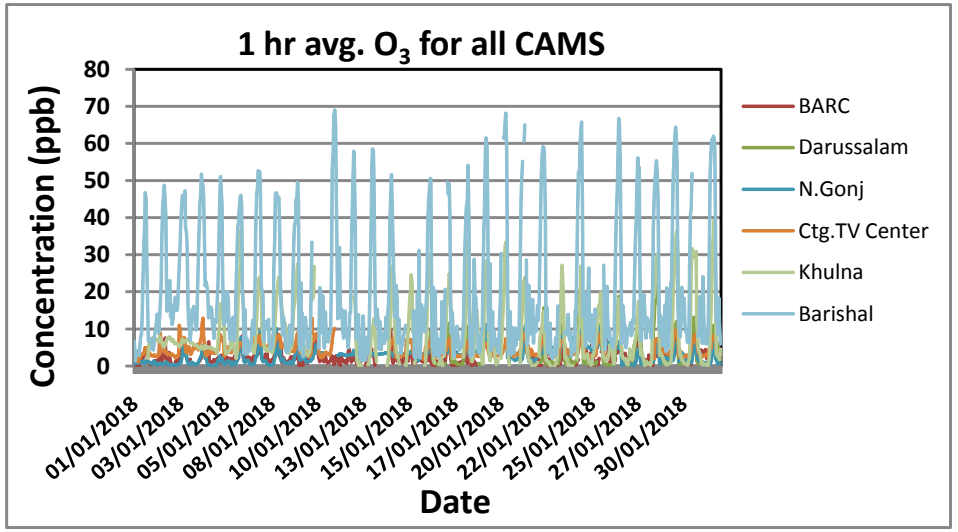
Parameter	unit	NAAQS	Summary	CAMS-1 (S-Bhaban)	CAMS-2 (BARC)[a]	CAMS-3 (D-salam)	CAMS-4 (Gazipur)	CAMS-5 (Narayonganj)	CAMS-6 TV-St (Chittagong)[a]	CAMS-7 Agrabad-(Chittagong)	CAMS-8 (Sylhet)	CAMS-9 (Khulna)[a]	CAMS-10 (Rajshahi)[a]	CAMS-11 (Barisal)
$PM_{2.5}$ -24hr	µg /m^3	65	Average	DNA	176	209	208	259	93.5	DNA	123	217	153	DNA
			Max	DNA	304	282	271	350	166	DNA	167	296	207	DNA
			Min	DNA	121	132	123	184	24.9	DNA	47.8	154	101	DNA
			Excedance(Days)	DNA	30	31	31	27	24	DNA	21	29	29	DNA
			Data capture(%)	DNA	85	94	85	75	84	DNA	62	85	87	DNA
PM_{10} -24hr	µg /m^3	150	Average	DNA	269	327	300	428	210	284	185	DNA	297	247
			Max	DNA	489	556	423	576	327	470	269	DNA	501	324
			Min	DNA	146	218	203	273	56.6	51.4	93.9	DNA	178	183
			Excedance(Days)	DNA	28	31	31	31	23	30	27	DNA	10	31
			Data capture(%)	DNA	85	94	86	92	78	78	88	DNA	27	88
Solar rad. 1hr	watt/m^2	NA	Average	DNA	367	121	DNA	DNA	80.2	139	135	136	144	129
			Max	DNA	458	619	DNA	DNA	98.1	678	638	669	301	623
			Min	DNA	294	7.55	DNA	DNA	9.53	6.99	7.17	2.18	98.6	8.02
			Data capture(%)	DNA	68	98	DNA	DNA	81	90	96	16	95	94
Relative Humidity 1hr	(%)	NA	Average	DNA	67.4	69.4	DNA	DNA	80.2	67.1	82.5	DNA	79.8	76.8
			Max	DNA	98.7	97.0	DNA	DNA	98.1	95.3	99.4	DNA	96.6	99.5
			Min	DNA	24.2	27.8	DNA	DNA	9.53	26.6	38.5	DNA	20.3	28.3
			Data capture(%)	DNA	68	98	DNA	DNA	81	90	96	DNA	97	94
Ambient Temp. 1hr	(°c)	NA	Average	DNA	23.6	17.9	DNA	DNA	17.6	19.3	18.2	12.8	19.4	18.8
			Max	DNA	30.9	26.9	DNA	DNA	26.1	26.2	26.5	20.3	35.5	29.5
			Min	DNA	17.3	9.45	DNA	DNA	9.17	11.2	10.7	7.21	10.7	10.1
			Data capture(%)	DNA	68	98	DNA	DNA	85	90	96	16	97	94
Rainfall 1hr	(m.m.)	NA	Average	DNA	0.33	DNA	1.76	DNA	DNA	0.02	DNA	DNA	DNA	DNA
			Max	DNA	1.98	DNA	3.51	DNA	DNA	0.95	DNA	DNA	DNA	DNA
			Min	DNA	0.03	DNA	0.10	DNA	DNA	0.02	DNA	DNA	DNA	DNA
			Data capture(%)	DNA	24	DNA	93	DNA	DNA	79	DNA	DNA	DNA	DNA

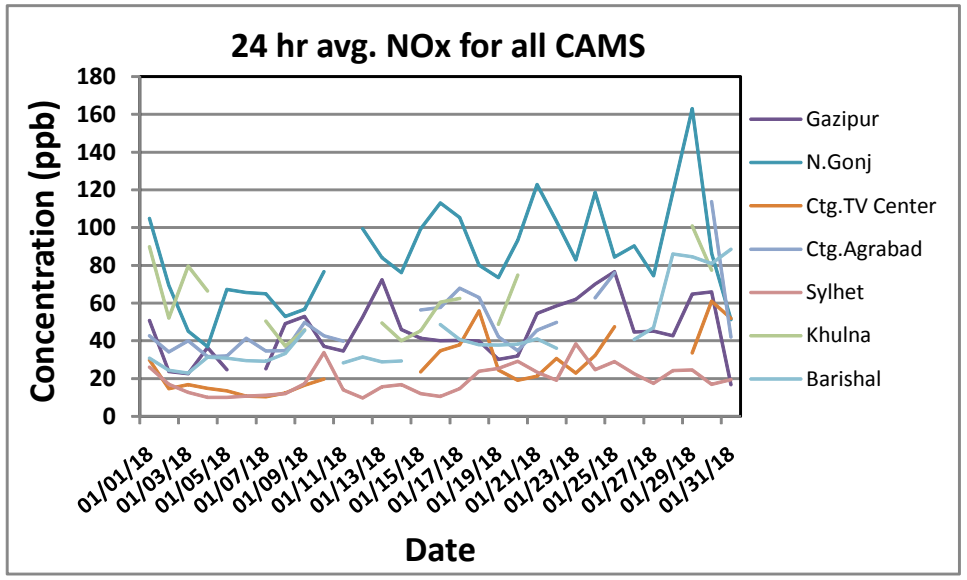
CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, a=Refurbisment CAMS, PM= Particulate Matter

DNA= Data Not Available

FIGURE 3: TIME SERIES OF ALL PARAMETERS (SO_2, NOx AND O_3) MEASURED IN ALL CAMS DURING JANUARY, 2018







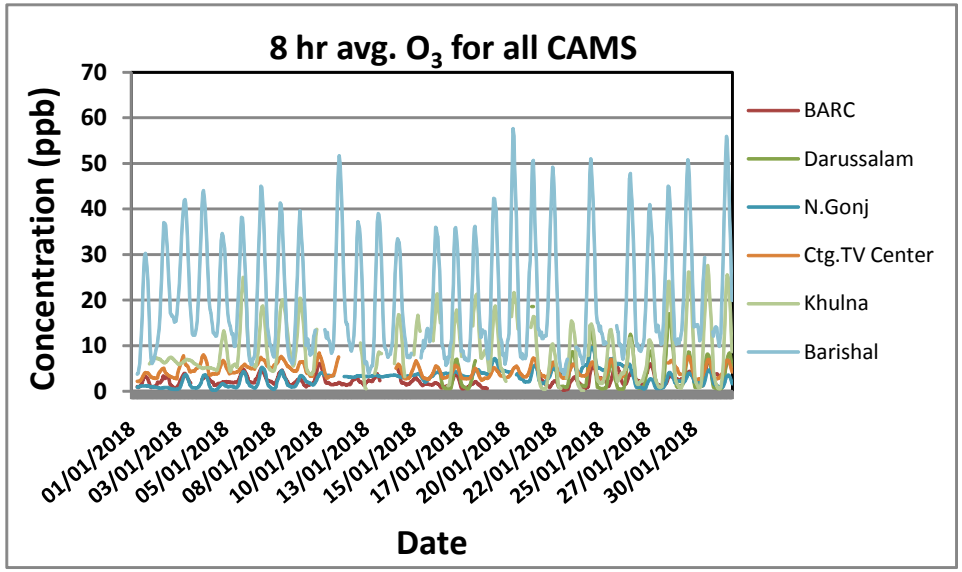
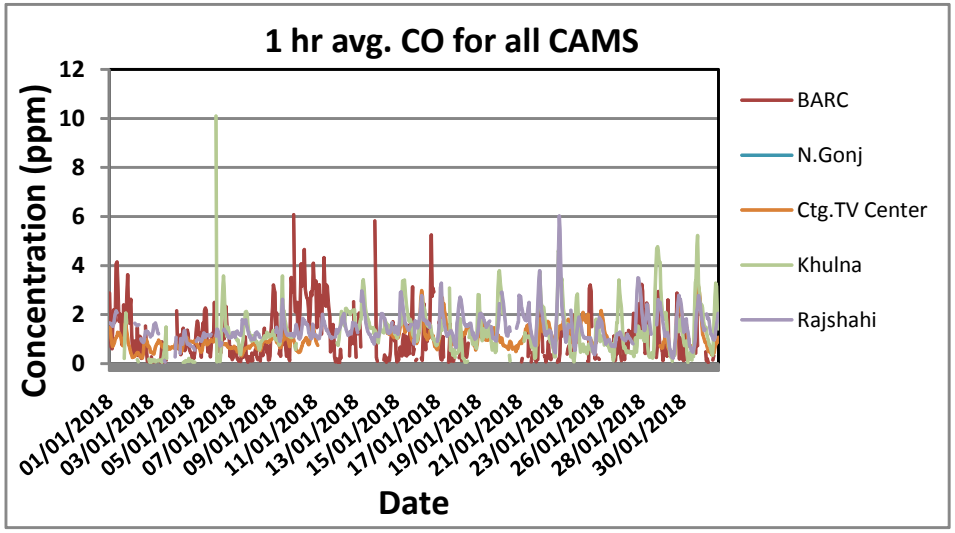
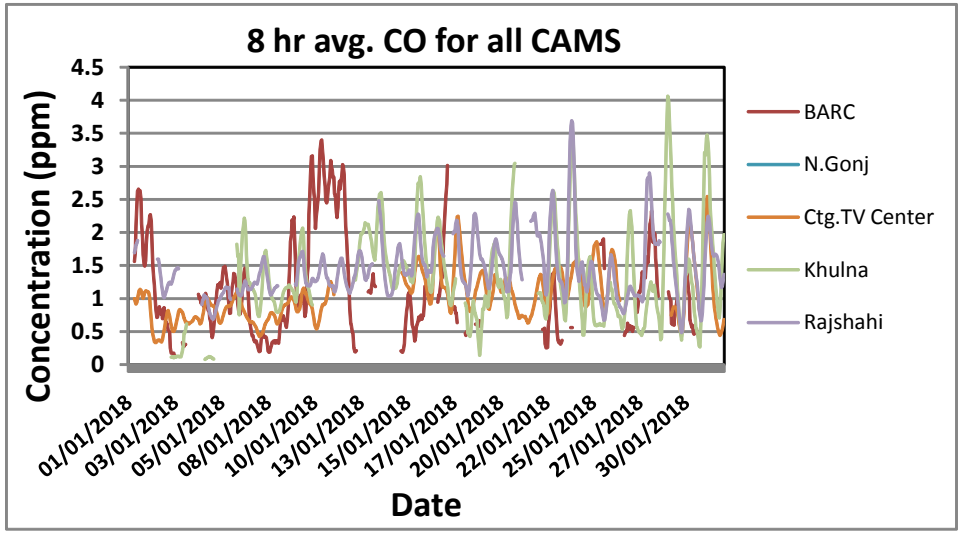
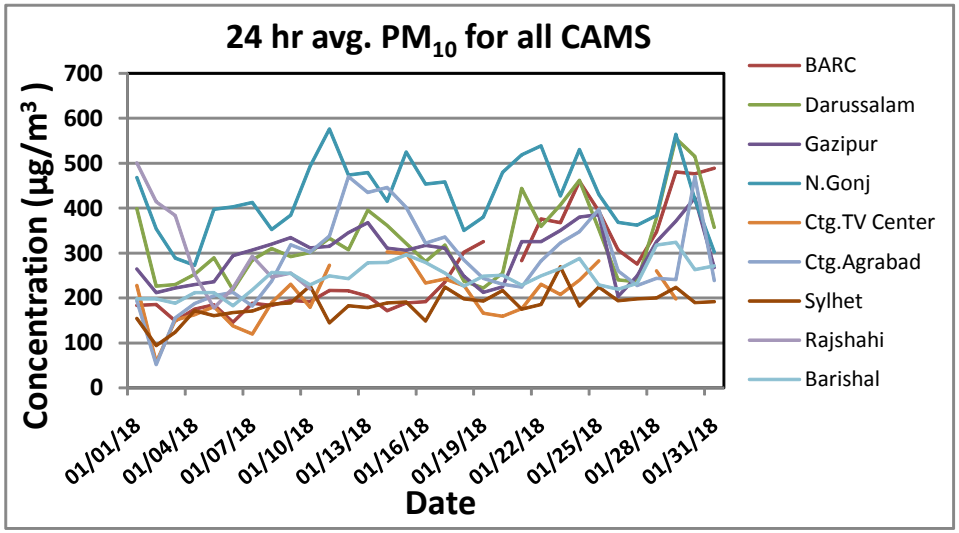


FIGURE 4: TIME SERIES OF ALL PARAMETERS (CO,PM10 AND PM2.5) MEASURED IN CAMS DURING JANUARY, 2018







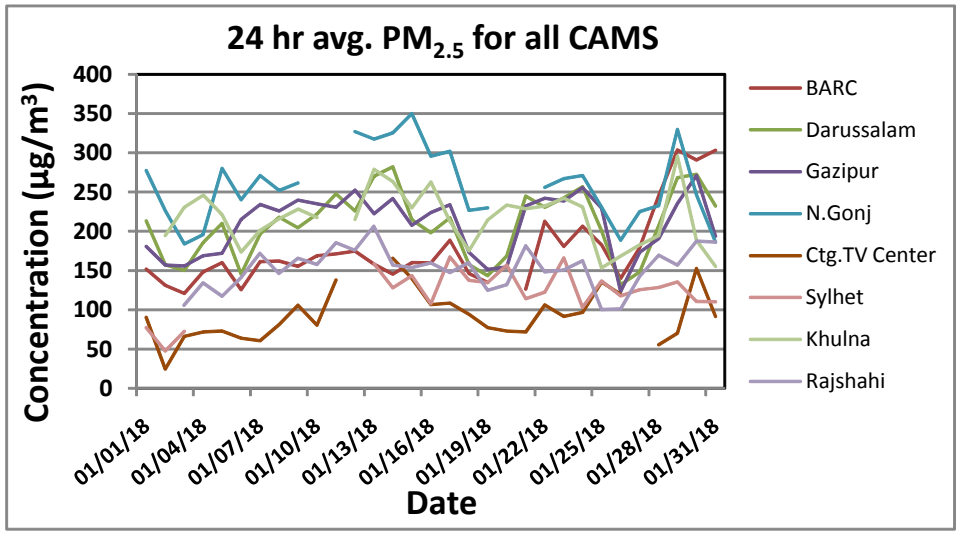
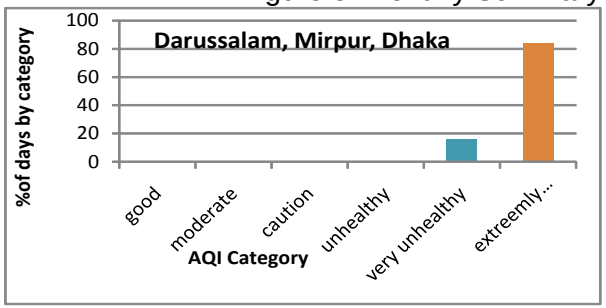
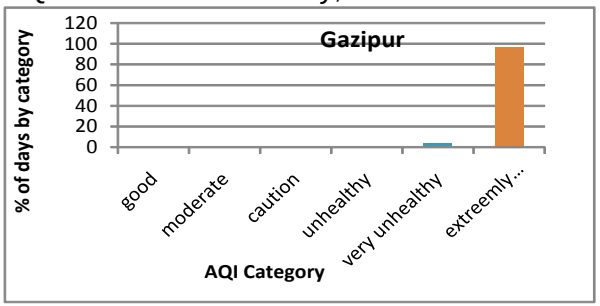
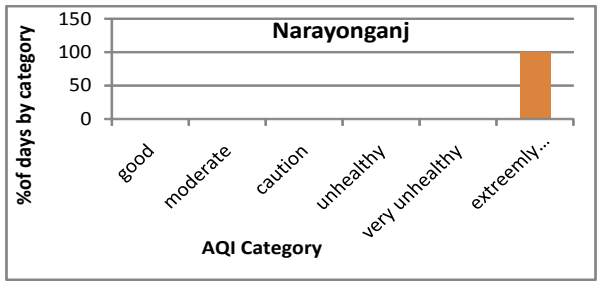
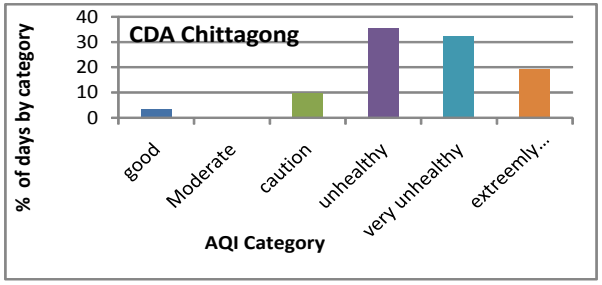


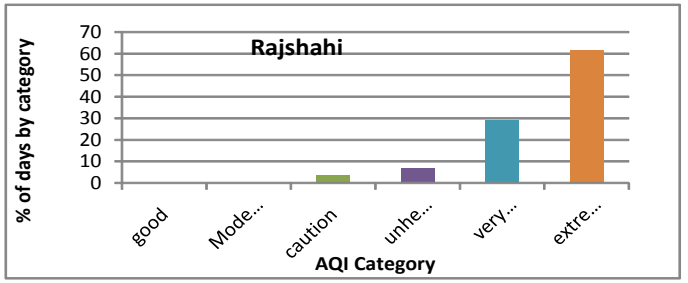
Figure 5: Monthly Summary of AQI for month of January, 2018

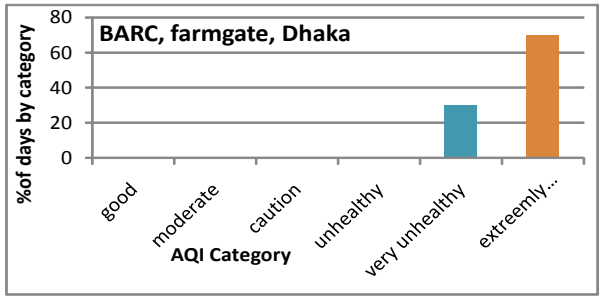


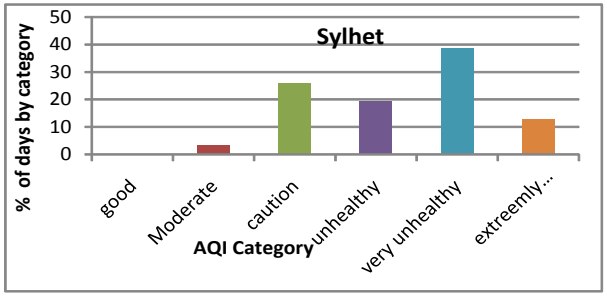


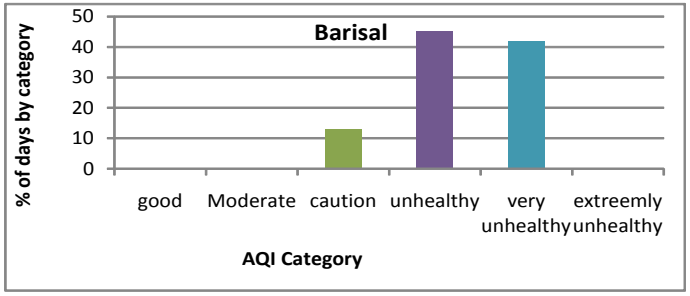


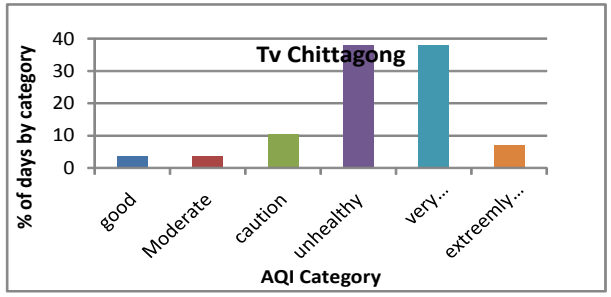


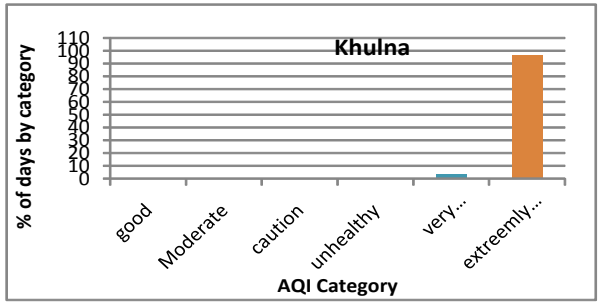












ANNEX