

Government of the People's Republic of Bangladesh

Ministry of Environment and Forests

**Monthly Air Quality Monitoring Report
Reporting Month: December, 2017**

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

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Department of Environment

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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, Narayanganj, 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 µg/m³
- (c) The objective is attained when the expected number of days per calendar year with a 24-hour average of 150 µg/m³ 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	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 December, 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 NO_x 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 & PM_{2.5} levels at all monitoring stations during the month of December, 2017. It is observed that the 24 hr average concentration level of PM_{2.5} exceeded BNAAQS for 28 days in BARC and Gazipur, 27 days in Narayanganj, 26 days in D.salam and Rajshahi, 13 days in Barishal, 21 days in Khulna, 05 days in TV station, Ctg and 13 days at Shylet CAMS during the month of December, 2017. For PM₁₀ non-attainment with respect to BNAAQS occurred for 27 days at Narayanganj CAMS, 29 days in Rajshahi, 26 days in D.Salam & BARC, 28 days in Gazipur, 09 days in TV station and 26 days in Agrabad, Ctg, 06 days in Sylhet, 26 days at Barishal and 01 day in Khulna CAMS during the reporting month. The monthly average concentration level of PM_{2.5} and PM₁₀ measured at different CAMS were found 11-210 µg/m³ and 22-415 µg/m³ respectively during the monitoring month of December, 2017. The concentration level of those was found 51-147 µg/m³ and 71-277 µg/m³ respectively during the month of November, 2017. From the time series plot of both PM₁₀ and PM_{2.5}, it is seen in most cases PM concentrations lower 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 December, 2017.

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 December, 2017. 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 Caution to Very unhealthy.

4. Summary and conclusion

Data obtained from CAMS operated under DoE air quality monitoring network during December, 2017 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:

- PM₁₀ and PM_{2.5} are the most critical pollutants. 24-hour average for both PM₁₀ and PM_{2.5} concentrations were found slightly higher than the BNAAQS during the month of November, 2017 with few exceptions. It is observed that the average concentration level of PM_{2.5} and PM₁₀ measured at different CAMS were 11-210 µg/m³ and 22-415 µg/m³ respectively during the month of December, 2017.
- The gaseous pollutants measured at different CAMS did not exceed limit values of the BNAAQS.
- Due to decreasing average wind speed and lower precipitation during December, 2017, the 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 Caution to Very 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.

Table 3: Summary Air Quality and Meteorological data measured during December, 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 (Narayong anj)	CAMS-6 TV-St (Chittagong) ^a	CAMS-7 Agrabad- (Chittagon g)	CAMS-8 (Sylhet)	CAMS-9 (Khulna) ^a	CAMS-10 (Rajshahi) ^a	CAMS-11 (Barisal)
SO ₂ -24 hr	ppb	140	Average	DNA	48.8	DNA	DNA	15.7	3.67	DNA	DNA	16.9	3.14	4.12
			Max	DNA	115	DNA	DNA	48.0	9.51	DNA	DNA	37.5	12.3	4.97
			Min	DNA	23.0	DNA	DNA	1.35	0.25	DNA	DNA	3.82	0.69	2.92
			Excedance(Days)	DNA	0	DNA	DNA	0	0	DNA	DNA	0	0	0
			Data capture(%)	DNA	92	DNA	DNA	72	32	DNA	DNA	68	59	92
NO ₂ -24 hr	ppb	53 (Annual)	Average	DNA	DNA	DNA	42.2	88.5	31.5	49.1	22.2	77.9	DNA	36.5
			Max	DNA	DNA	DNA	91.5	130	53.8	90.9	37.3	105	DNA	59.0
			Min	DNA	DNA	DNA	20.9	54.7	11.4	26.2	9.83	57.1	DNA	17.4
			Excedance(Days)	DNA	DNA	DNA	2	28	1	7	0	17	DNA	1
			Data capture(%)	DNA	DNA	DNA	30	91	51	85	98	68	DNA	93
CO- 1 hr	ppm	35	Average	0.70	1.33	3.26	3.91	0.87	0.87	DNA	DNA	DNA	DNA	1.75
			Max	1.34	6.23	6.29	7.33	4.68	2.86	DNA	DNA	DNA	DNA	5.5
			Min	0.21	0.05	2.26	2.12	0.05	0.19	DNA	DNA	DNA	DNA	0.59
			Excedance(Hour)	0	0	0	0	0	0	DNA	DNA	DNA	DNA	0
			Data capture(%)	47	87	99	98	55	40	DNA	DNA	DNA	DNA	34
CO-8hr	ppm	9	Average	0.70	1.37	3.26	3.89	0.88	0.88	DNA	DNA	DNA	DNA	1.76
			Max	1.28	4.41	4.78	6.25	2.64	2.23	DNA	DNA	DNA	DNA	3.76
			Min	0.33	0.13	2.35	2.40	0.11	0.28	DNA	DNA	DNA	DNA	0.81
			Excedance(Hour)	0	0	0	0	0	0	DNA	DNA	DNA	DNA	0
			Data capture(%)	45	82	98	97	53	39	DNA	DNA	DNA	DNA	33
O ₃ -1hr	ppb	120	Average	DNA	1.55	DNA	DNA	1.32	3.48	DNA	DNA	DNA	5.08	12.4
			Max	DNA	10.4	DNA	DNA	17.3	6.64	DNA	DNA	DNA	75.1	52.2
			Min	DNA	0.05	DNA	DNA	0.05	0.56	DNA	DNA	DNA	0.25	0.36
			Excedance(Hour)	DNA	0	DNA	DNA	0	0	DNA	DNA	DNA	0	0
			Data capture(%)	DNA	96	DNA	DNA	89	51	DNA	DNA	DNA	96	93
O ₃ -8hr	ppb	80	Average	DNA	1.52	DNA	DNA	1.36	3.49	DNA	DNA	DNA	5.06	12.4
			Max	DNA	6.57	DNA	DNA	10.9	5.87	DNA	DNA	DNA	18.7	41.3
			Min	DNA	0.29	DNA	DNA	0.11	1.91	DNA	DNA	DNA	1.92	0.79
			Excedance(Hour)	DNA	0	DNA	DNA	0	0	DNA	DNA	DNA	0	0
			Data capture(%)	DNA	95	DNA	DNA	88	49	DNA	DNA	DNA	97	91

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

DNA= Data Not Available

Table 3: Summary Air Quality and Meteorological data measured during December, 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 (Narayong anj)	CAMS-6 TV-St (Chittagong) ^a	CAMS-7 Agrabad- (Chittagong g)	CAMS-8 (Sylhet)	CAMS-9 (Khulna) ^a	CAMS-10 (Rajshahi) ^a	CAMS-11 (Barisal)
PM _{2.5} -24hr	µg /m ³	65	Average	DNA	124	147	138	224	56.2	DNA	63.0	116	111	120
			Max	DNA	188	203	210	297	87.8	DNA	106	161	188	210
			Min	DNA	33.1	17.4	11.5	159	16.7	DNA	11.7	14.3	18.8	34.4
			Excedance(Days)	DNA	28	26	28	27	5	DNA	13	21	26	13
			Data capture(%)	DNA	96	88	97	73	51	DNA	89	58	87	27
PM ₁₀ -24hr	µg /m ³	150	Average	DNA	175	257	209	396	143	178	125	117	276	182
			Max	DNA	255	394	323	558	230	293	191	232	415	252
			Min	DNA	60.3	22.7	12.6	297	44.3	39.5	20.6	70.3	76.8	39.7
			Excedance(Days)	DNA	26	26	28	27	9	26	6	1	29	26
			Data capture(%)	DNA	92	90	88	75	51	80	89	17	89	87
Solar rad. 1hr	watt/m ²	NA	Average	DNA	DNA	106	DNA	DNA	DNA	136	143	DNA	128	120
			Max	DNA	DNA	692	DNA	DNA	DNA	626	674	DNA	331	695
			Min	DNA	DNA	7.41	DNA	DNA	DNA	7.13	6.75	DNA	121	8.09
			Data capture(%)	DNA	DNA	99	DNA	DNA	DNA	91	98	DNA	96	93
Relative Humidity 1hr	(%)	NA	Average	DNA	60.8	74.7	DNA	DNA	86.9	72.1	77.6	DNA	86.1	84.2
			Max	DNA	98.6	97.1	DNA	DNA	98.1	94.3	99.4	DNA	89.0	99.5
			Min	DNA	17.3	31.2	DNA	DNA	20.8	35.1	35.4	DNA	83.8	31.4
			Data capture(%)	DNA	97	99	DNA	DNA	49	91	98	DNA	97	93
Ambient Temp. 1hr	(°c)	NA	Average	DNA	26.8	21.9	DNA	DNA	20.7	22.4	21.5	DNA	35.5	22.2
			Max	DNA	32.6	29.6	DNA	DNA	28.5	35.2	28.8	DNA	37.0	31.4
			Min	DNA	12.3	15.4	DNA	DNA	13.5	16.5	15.9	DNA	34.4	16.0
			Data capture(%)	DNA	97	99	DNA	DNA	51	91	98	DNA	97	93
Rainfall 1hr	(m.m.)	NA	Average	0.02	0.94	0.07	1.67	DNA	DNA	0.03	0.38	DNA	DNA	DNA
			Max	0.04	4.52	5.18	3.46	DNA	DNA	0.82	4.20	DNA	DNA	DNA
			Min	0.02	0.03	0.02	0.02	DNA	DNA	0.02	0.02	DNA	DNA	DNA
			Data capture(%)	29	54	31	98	DNA	DNA	76	15	DNA	DNA	DNA

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

DNA= Data Not Available

FIGURE 3: TIME SERIES OF ALL PARAMETERS (SO₂, NO_x AND O₃) MEASURED IN ALL CAMS DURING DECEMBER, 2017

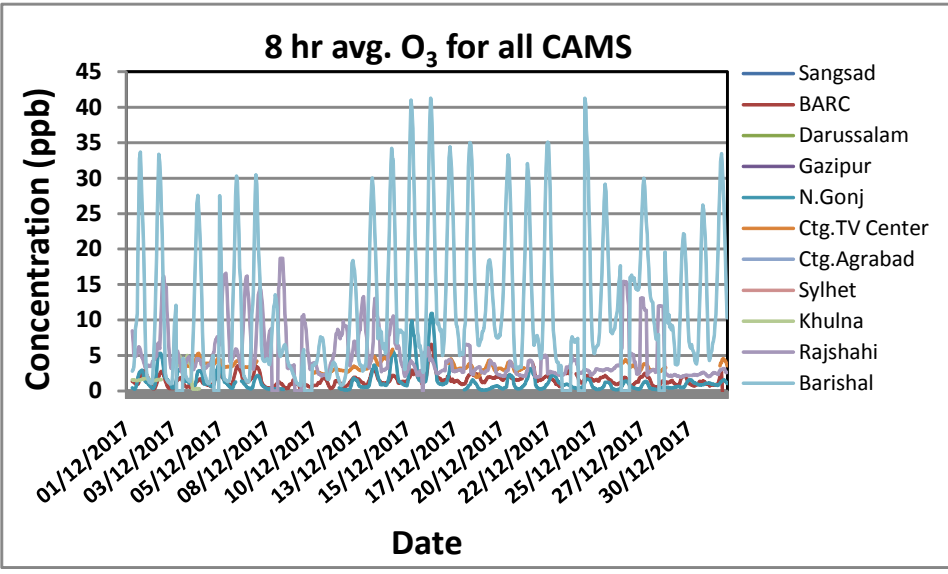
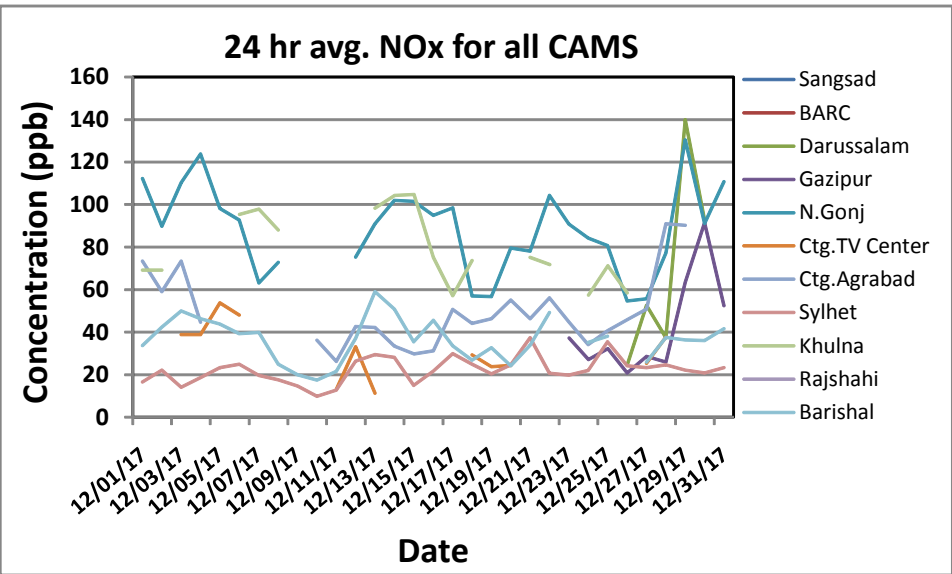
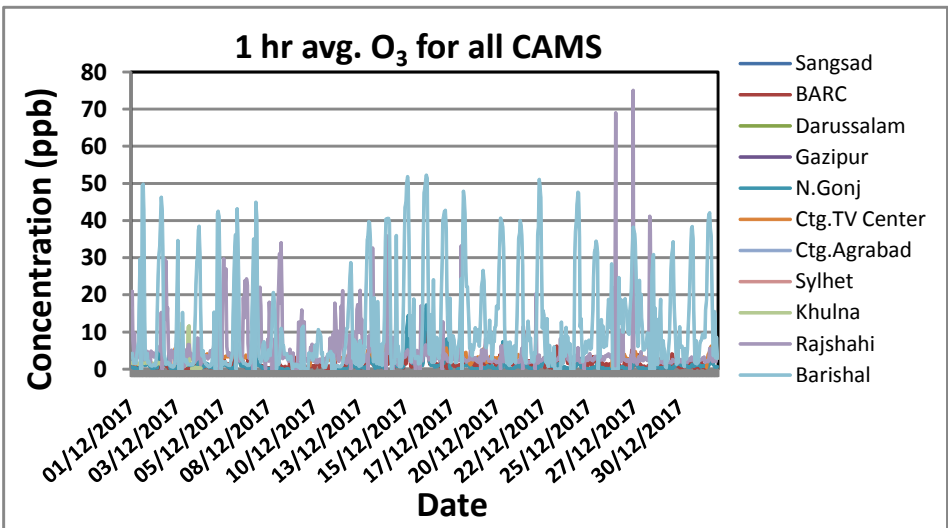
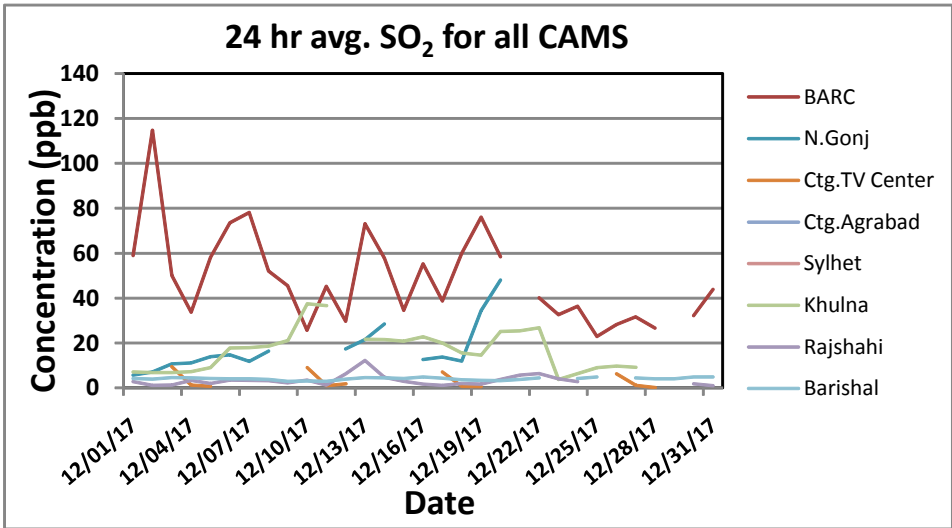


FIGURE 4: TIME SERIES OF ALL PARAMETERS (CO,PM10 AND PM2.5) MEASURED IN CAMS DURING DECEMBER, 2017

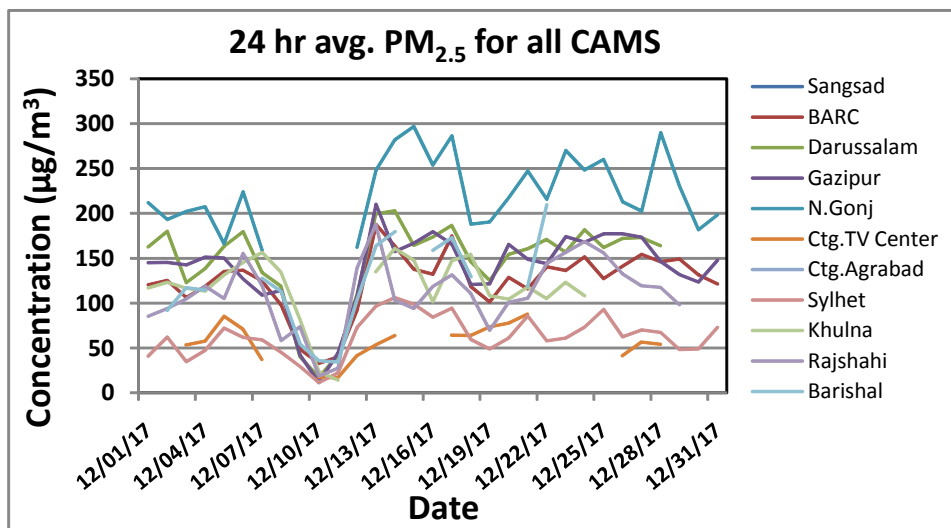
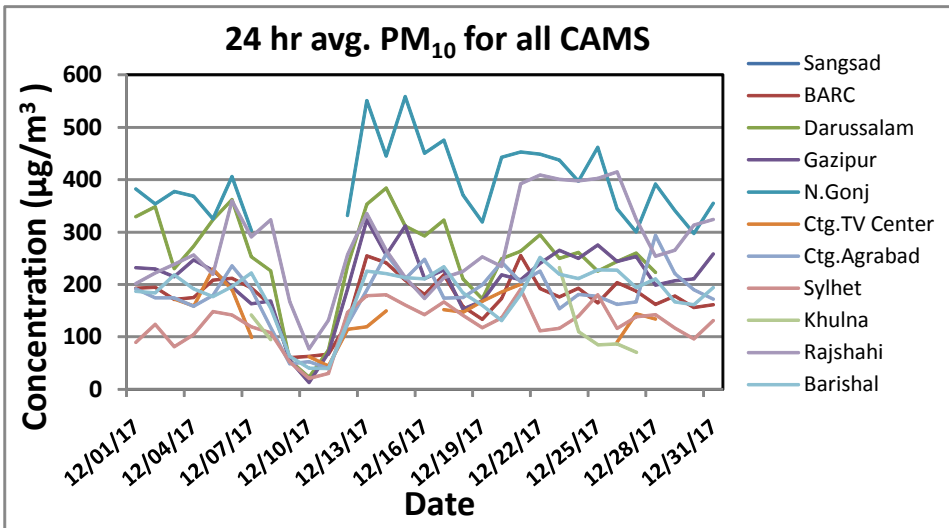
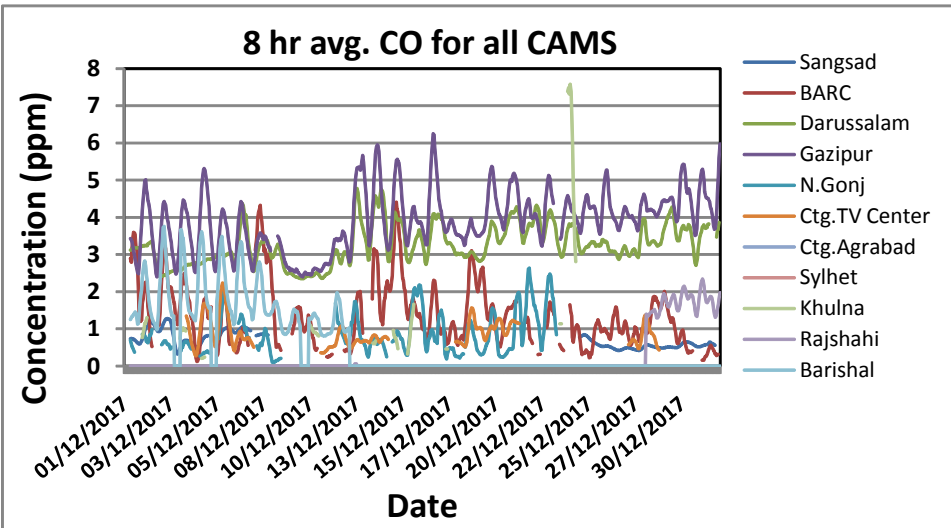
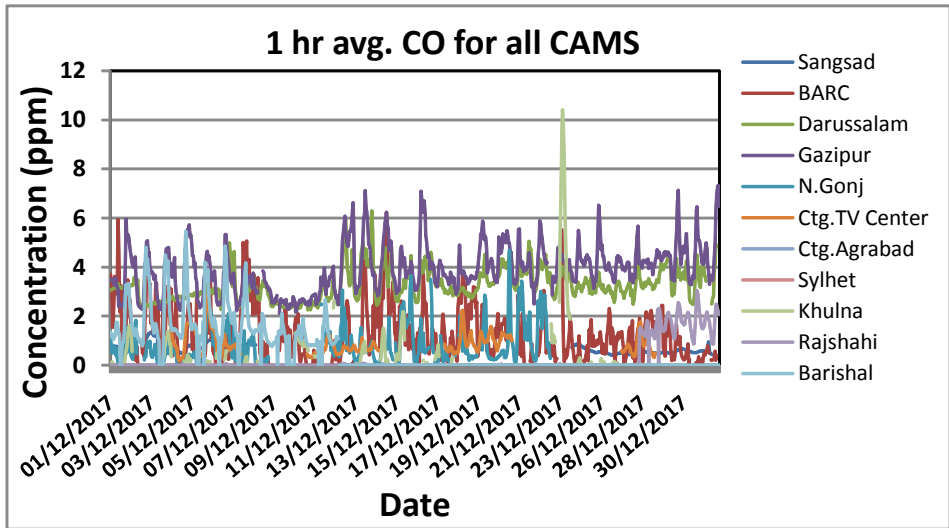


Figure 5: Monthly Summary of AQI for month of December, 2017

