Air Quality Monthly Report

May, 2013

Department of Environment
Ministry of Environment, Forest and Climate Change
Bangladesh

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 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	PM10, PM2.5, CO, SO2, NOX,

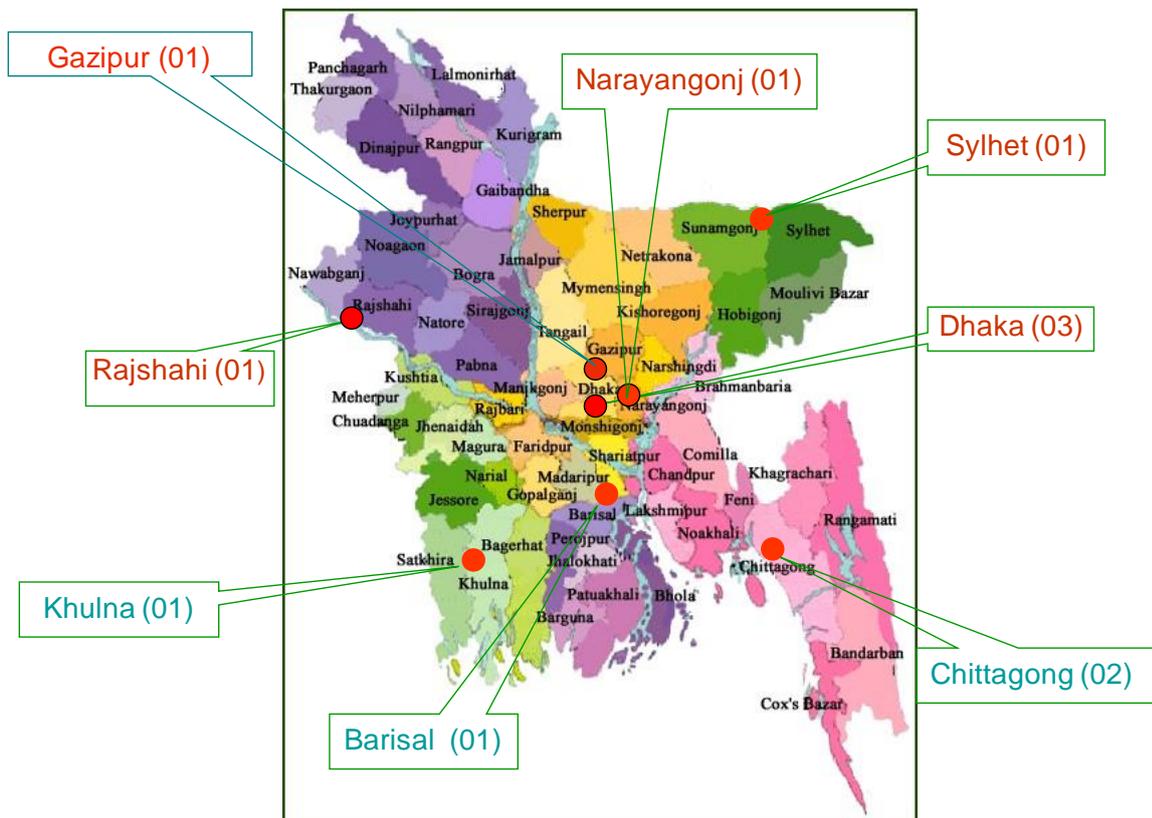| City	ID	Location	Lat/Lon	Monitoring capacity
			88.61E	O3, and HC with meteorological parameters.
Sylhet	CAMS-10	Red Crecent Campus	24.89N 91.87E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Barisal	CAMS-11	DFO office campus	22.71N 90.36E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological 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 measurements during May 2013 at 11 CAMS operated under 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 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 availability (valid data) found to be over 80% except few parameters in all 11 CAMS. In case of data capture rate below 75% for a particular averaging time are not reported. A few of the analyzers at different CAMS were under maintenance and eventually the data capture rate for those parameters found low. Data capture is low for all parameters in Narayonganj CAMS due to burning of the electric meter because of unexpected high voltage in the power supply line. Replacement of the electrical meter and restoration of power supply took some time and thus the station remained shut down for about<??> days. There were no occurrences of non-compliance for PM10 levels at all the stations during the month of May. The PM2.5 concentrations were also found compliance with the BNAAQS except at TV station Chittagong and at Khulna. It is observed that the concentration level of PM2.5 exceeded the BNAAQS only for 02 days at Chittagong TV station CAMS and 1 day at Khulna CAMS respectively during May 2013. PM levels in all cities are gradually decreasing because dry season in over & precipitation is increasing. It is also observed that all the gaseous pollutants except NO_x in few CAMS did not exceed the BNAAQS. In case of NO_x concentrations, there was non-attainment for 25 days and 8 days at BARC (Dhaka) and Rajshahi CAMS respectively.

In general PM pollution levels in the cities monitored during the reporting month was good compared to previous month in respect of public health. Usually in the dry seasons the pollution level reached its peak and gradually decreases when dry season is over which is reflected in the data monitored in all CAMS during month of May. It observed that average wind speed and precipitation compared to previous month of April has increased, which helped higher dispersion of the pollutants and this might be a reason for observed lower PM concentration.

Wind frequency distributions, also called Wind roses for all CAMS except TV-Station Chittagong, Rajshahi and Khulna (no wind data available for those stations) under the monitoring network are presented in Figure 2. From the wind rose patterns it is observed that the predominant wind direction during the Month May 2013 were mainly from south-east to south-west direction with few exceptions.

4.   Summary and conclusion

Data obtained from 11 CAMS operated under DoE air quality monitoring network during May 2013 have been analyzed and reported. Data availability was over 80% for all the criteria pollutant monitored at different CAMS. 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 and 24-hour average for both PM10 concentrations were found compliance with the BNAAQS whereas the PM2.5 concentrations only exceeded for 02 days at Chittagong TV station CAMS and 1 day at Khulna CAMS respectively during May 2013..
- Gaseous pollutants except NO_x did not exceeded limit values at all the CAMS except BARC and Rajshahi CAMS. NO_x concentration exceeded the limit values for 25 and 8 days at BARC (Dhaka) and Rajshahi CAMS.
- Due to increased average wind speed and precipitation during May-13, dispersion and wash out of pollutants has increased thus helped decreasing the pollution concentration levels.

Although manual data quality checks and screening performed, further strict quality assurance programme that will be developed for this programme will eventually improve the data quality.

Table 3: Summary Air Quality and Meteorological data measured during May 2013 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	1.29	5.38	1.06	6.74	5.12	3.03	4.75	5.61	2.36	2.51	DNA*
			Max	3.68	9.48	2.07	10.04	11.52	4.98	16.05	8.21	4.30	6.66	DNA*
			Min	0.48	2.52	0.64	4.20	2.77	1.30	0.50	4.42	1.17	0.63	DNA*
			Excedance(Days)	0	0	0	0	0	0.00	0	0	0	0	DNA*
			Data capture(%)	100.00	93.55	96.77	100.00	58.06	64.52	96.77	63.33	48.39	61.29	DNA*
NOx -24 hr	ppb	53 (Annual)	Average	4.16	65.91	11.90	14.79	13.17	DNA**	11.45	DNA**	19.66	51.71	DNA*
			Max	26.53	90.09	19.12	19.17	19.54	DNA**	18.57	DNA**	25.13	65.76	DNA*
			Min	0.52	36.19	5.02	8.29	5.04	DNA**	2.31	DNA**	9.61	36.43	DNA*
			Excedance(Days)	0	25	0	0	0	DNA**	0	DNA**	0	8	DNA*
			Data capture(%)	51.61	100.00	70.97	100.00	58.06	DNA**	96.77	DNA**	58.06	51.61	DNA*
CO- 1 hr	ppm	35	Average	0.43	1.05	0.90	1.54	DNA**	0.79	1.11	3.14	1.49	0.66	0.81
			Max	1.06	2.97	1.86	2.40	DNA**	2.21	3.66	5.01	5.72	3.15	1.88
			Min	0.27	0.05	0.34	0.54	DNA**	0.22	0.57	2.42	0.05	0.12	0.52
			Excedance(Hour)	0.00	0.00	0.00	0.00	DNA**	0.00	0.00	0.00	0.00	0.00	0.00
			Data capture(%)	94.76	93.68	98.66	97.45	DNA**	90.19	97.31	78.19	72.72	82.26	88.17
CO-8hr	ppm	9	Average	0.42	1.01	0.90	1.54	DNA**	0.78	1.12	3.13	1.49	0.69	0.82
			Max	0.80	2.52	1.52	1.93	DNA**	1.16	2.60	4.42	5.44	3.15	1.79
			Min	0.27	0.05	0.41	0.77	DNA**	0.37	0.88	2.80	0.09	0.12	0.56
			Excedance(Hour)	0.00	0.00	0.00	0.00	DNA**	0.00	0.00	0.00	0.00	0.00	0.00
			Data capture(%)	95.03	98.92	99.06	99.06	DNA**	93.01	98.25	86.25	92.88	87.90	95.83
O_3-1hr	ppb	120	Average	1.11	13.94	2.41	10.57	12.50	18.27	13.45	12.44	8.83	13.64	7.75
			Max	26.88	42.11	10.49	36.45	40.50	49.29	40.21	35.71	31.81	57.59	24.28
			Min	0.05	9.58	1.02	2.54	1.64	9.14	0.16	1.65	1.03	0.06	0.10
			Excedance(Hour)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Data capture(%)	100.00	99.60	93.15	97.45	61.42	90.05	97.04	78.06	78.23	80.24	76.21
O_3-8hr	ppb	80	Average	1.09	13.97	2.40	10.65	12.29	18.41	13.55	12.87	8.89	12.71	7.66
			Max	22.89	32.14	8.24	28.92	34.28	37.21	34.27	30.97	21.73	57.59	18.06
			Min	0.12	10.00	1.02	2.67	1.86	9.54	0.40	2.16	1.92	0.10	0.10
			Excedance(Hour)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Data capture(%)	99.06	99.06	98.12	98.79	67.07	93.01	98.25	86.25	94.76	87.90	84.27

DNA*=due to malfunction of analyzer/sensor, DNA**= due to poor data capture NA= Not Applicable, PM= Particulate Matter,
a=Refurbished CAMS, NAAQS=National Ambient Air Quality Standard, CAMS= Continuous Air Monitoring Station,

Table 3: Summary Air Quality and Meteorological data measured during May 2013 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	27.69	32.15	36.62	28.34	24.11	35.31	30.44	21.68	34.62	34.92	31.44
			Max	43.87	52.01	46.57	48.28	37.90	75.99	54.69	31.75	72.42	49.50	48.23
			Min	17.20	12.09	19.79	12.84	15.36	10.61	13.41	14.44	13.33	14.43	20.27
			Excedance(Days)	0	0	0	0	0	2.00	0	0	1	0	0
			Data capture(%)	45	93.55	87	94	48	87.10	65	63	51.61	83.87	77.42
PM_{10} -24hr	µg /m^3	150	Average	62.04	62.28	72.95	38.58	64.90	59.68	59.03	38.47	67.83	DNA**	47.52
			Max	91.44	107.49	108.90	63.83	91.58	118.62	122.54	61.33	115.24	DNA**	80.53
			Min	44.08	30.89	33.83	18.54	37.26	21.74	32.98	22.52	26.26	DNA**	30.94
			Excedance(Days)	0	0	0	0	0	0.00	0	0	0	DNA**	0
			Data capture(%)	71	100	97	94	48	87.10	81	60	45.16	DNA**	74.19
Solar rad. 1hr	watt/ m^2	NA	Average	135.89	DNA*	182.00	168.81	170.77	DNA*	160.70	165.37	DNA*	DNA*	155.63
			Max	756.89	DNA*	1072.59	919.01	908.00	DNA*	908.89	989.02	DNA*	DNA*	886.83
			Min	5.25	DNA*	6.52	5.34	2.05	DNA*	7.49	5.46	DNA*	DNA*	7.17
			Data capture(%)	99.87	DNA*	97.45	97.45	61.56	DNA*	97.31	78.19	DNA*	DNA*	88.04
Relative Humidity 1hr	(%)	NA	Average	77.38	61.20	76.80	79.20	52.25	DNA*	78.52	82.50	89.84	75.86	81.31
			Max	94.97	64.08	94.05	93.97	66.43	DNA*	95.31	99.33	100.00	99.56	97.56
			Min	37.99	30.23	40.81	42.32	43.61	DNA*	44.64	50.56	38.01	37.71	33.26
			Data capture(%)	99.87	99.06	93.95	97.31	61.42	DNA*	96.64	78.19	69.22	83.06	88.04
Ambient Temp. 1hr	(ºc)	NA	Average	27.57	DNA*	27.27	29.79	DNA*	DNA*	27.01	27.02	28.61	28.19	30.81
			Max	37.34	DNA*	36.69	40.29	DNA*	DNA*	33.59	36.08	35.90	41.91	40.98
			Min	20.29	DNA*	11.18	20.51	DNA*	DNA*	20.32	21.07	22.30	11.27	24.90
			Data capture(%)	99.87	DNA*	93.82	97.31	DNA*	DNA*	96.64	78.19	70.56	44.22	88.04
Rainfall 1hr	(m.m.)	NA	Average	0.19	1.01	0.25	0.16	0.10	DNA**	0.27	0.36	0.57	DNA**	0.19
			Max	8.23	4.86	9.00	7.44	4.95	DNA**	8.57	11.92	20.44	DNA**	9.10
			Min	0.01	0.01	0.01	0.01	0.01	DNA**	0.01	0.01	0.01	DNA**	0.01
			Data capture(%)	99.87	78.36	93.95	97.45	58.06	DNA**	97.04	76.81	68.01	DNA**	77.96

DNA*=due to malfunction of analyzer/sensor, DNA**= due to poor data capture NA= Not Applicable, PM= Particulate Matter,

a=Refurbished CAMS, NAAQS=National Ambient Air Quality Standard, CAMS= Continuous Air Monitoring Station,
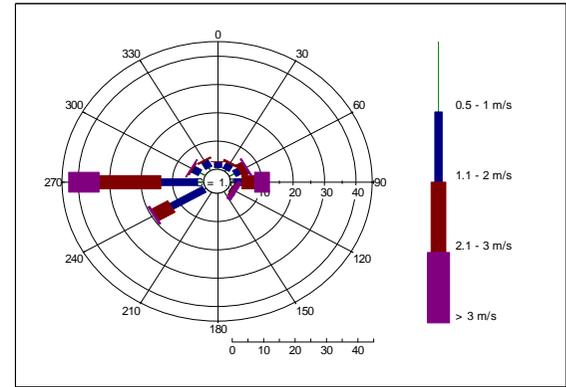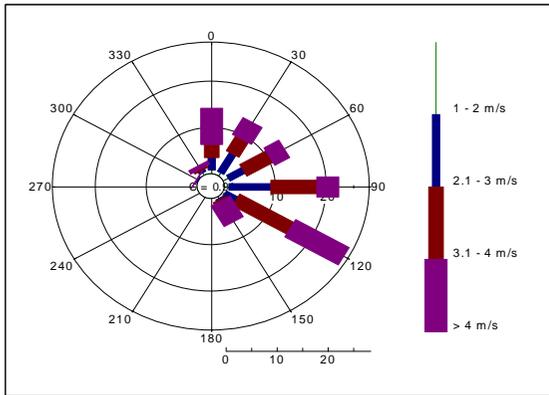
Wind Rose of Narayonganj CAMS for this month
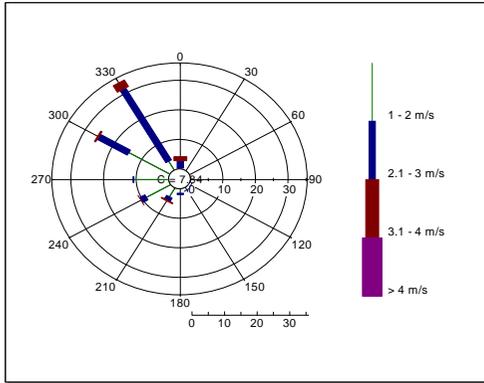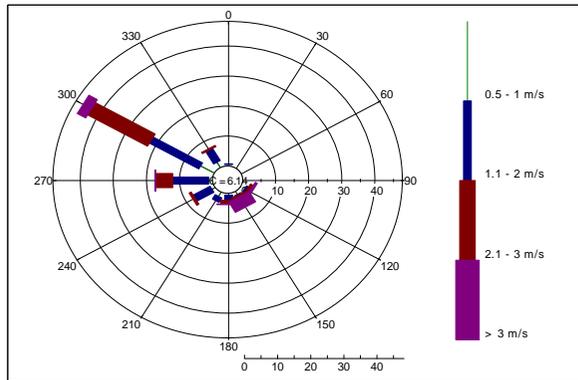
Wind Rose of Agrabad, Chittagong CAMS for this month
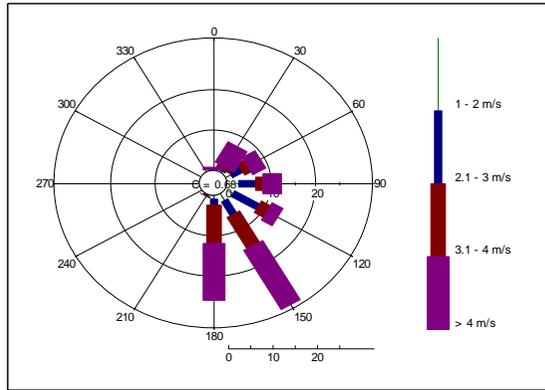
Wind Rose of BARC CAMS for this month

Wind Rose of Darussalam CAMS for this month

Wind Rose of Sangsad Bhaban CAMS for this month
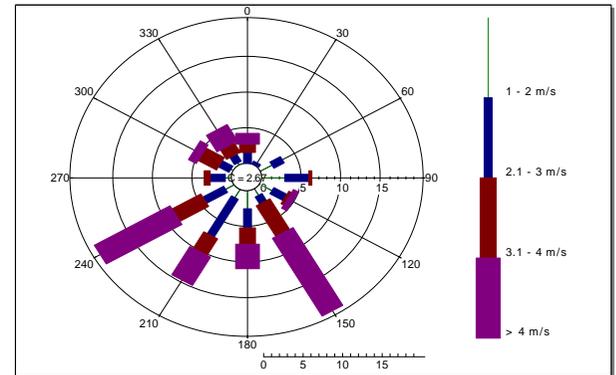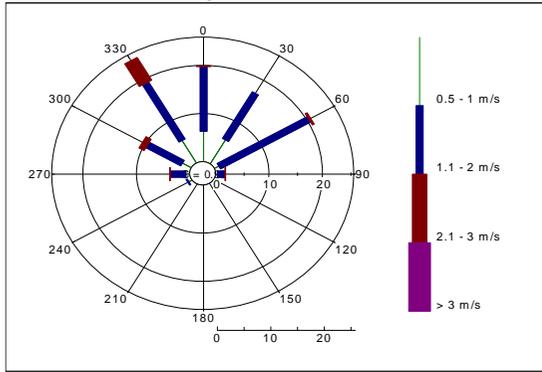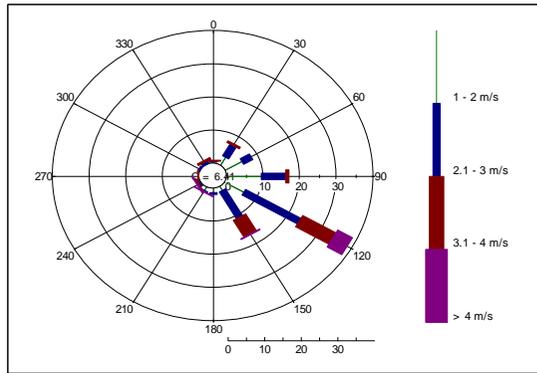
Wind Rose of Sylhet CAMS for this month

Figure 2: Wind frequency distributions (wind roses) from different CAMS monitored for May 2013.

Wind Rose of Gazipur CAMS for this month

Wind Rose of Barisal CAMS for this month

Wind Rose of Rajshahi CAMS for this month

Wind Rose of TV-Chittagong CAMS for this month

Wind Rose of Khulna CAMS for this month

Figure 2: Wind frequency distributions (wind roses) from different CAMS monitored for May 2013 (cont'd).

TIME SERIES OF ALL PARAMETERS (SO2, NOx and O3) MEASURED IN ALL CAMS DURING May 2013
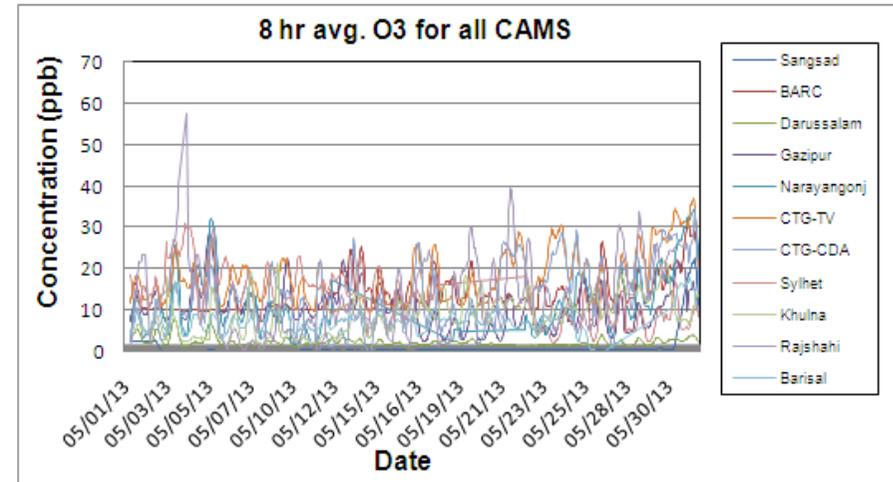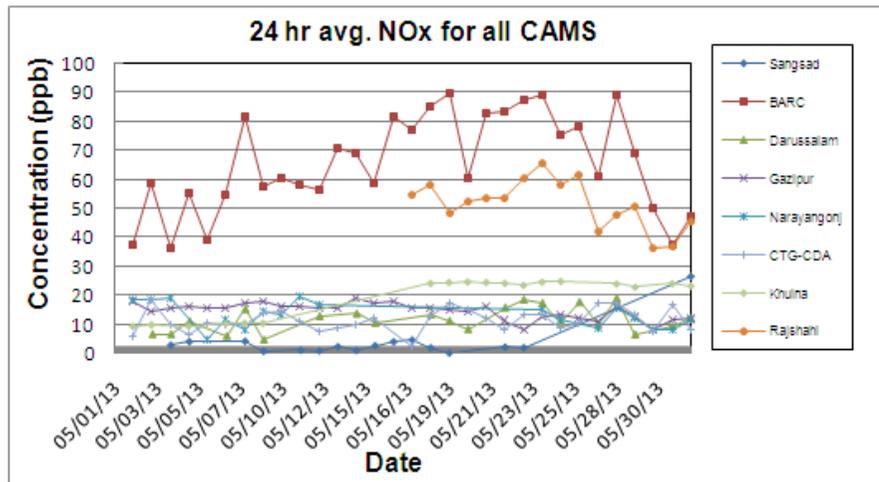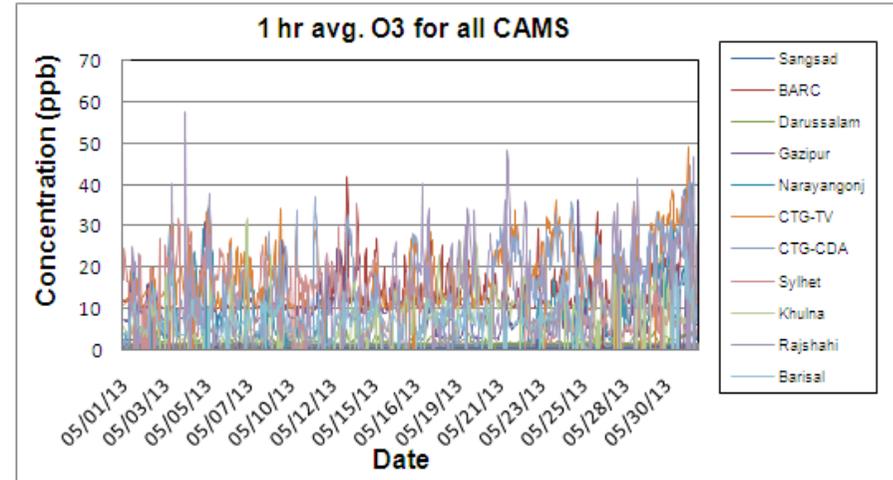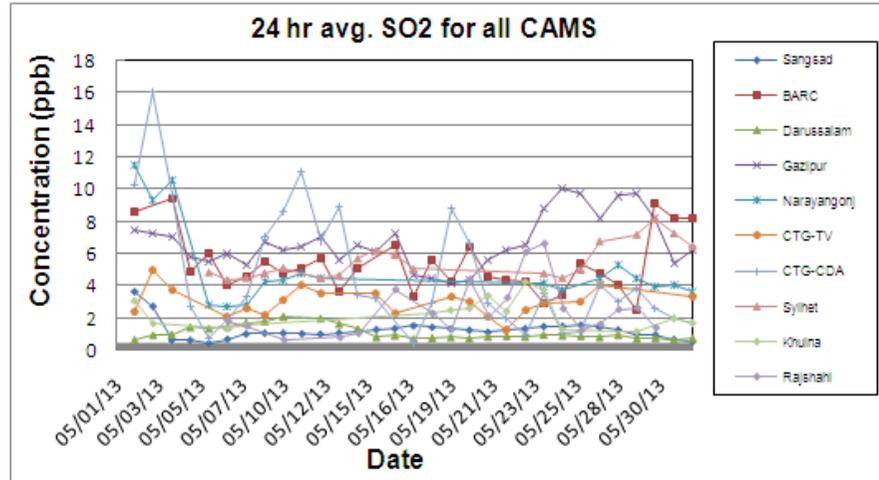
TIME SERIES OF ALL PARAMETERS (CO, PM10 and PM2.5) MEASURED IN CAMS DURING May, 2013