

Government of the People's Republic of Bangladesh

Ministry of Environment and Forest

Monthly Air Quality Monitoring Report
Reporting Month: March 2013

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

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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 ₂	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	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.

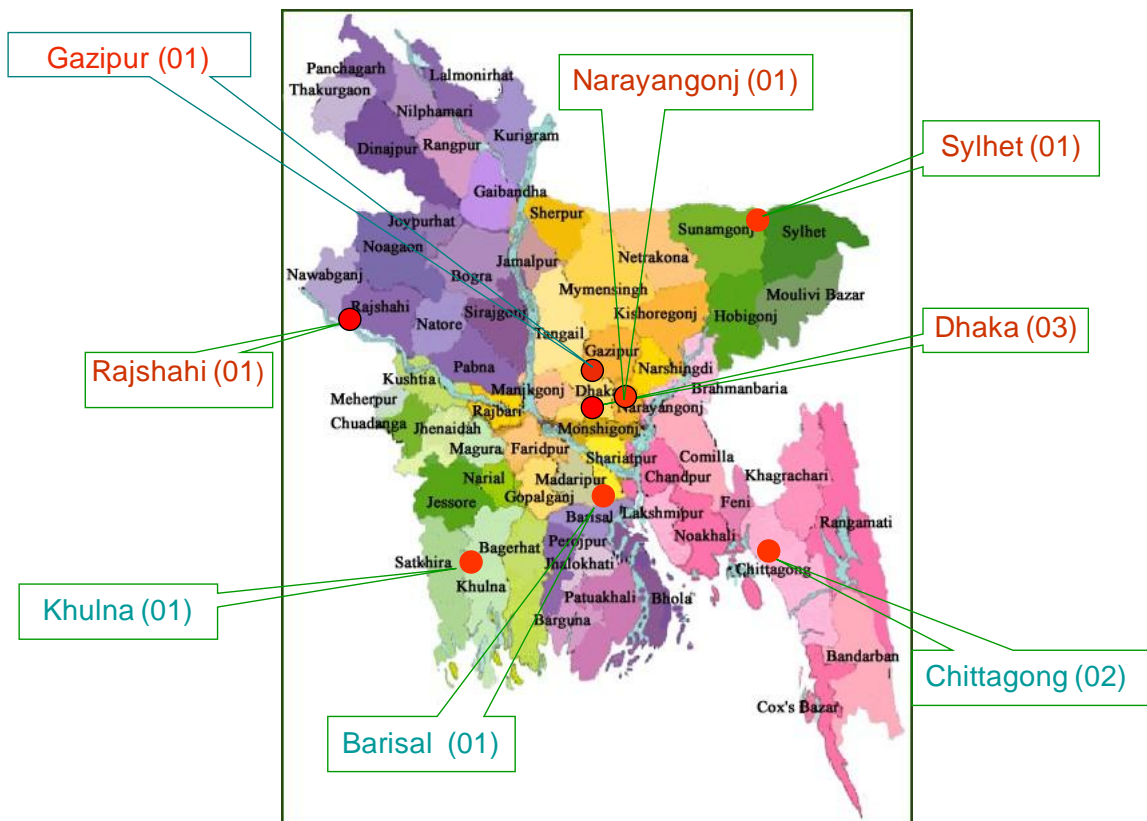


Figure 1: CAMS Location in Bangladesh

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 AIRQus system established under BAPMAN project. The data are stored in AIRQus 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 March 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 (BNAQS). Since NO₂ 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. It is to be noted that due to unavoidable reason no data were available for Chattagong TV station CAMS.

In general the data availability (valid data) found to be over 80% except few parameters. A few of the analyzers at different CAMS were under maintenance and eventually the data capture rate for those parameters found low. No data was available for Chittagong TV Station CAMS, because the station was not operational due to unavoidable reasons. It is observed that for both fractions of particulate matter (PM₁₀ and PM_{2.5}), the concentrations levels exceeded the BNAQS for Majority of the days monitored at 10 CAMS during March 2013. During dry seasons PM levels in cities are usually high, because of low precipitation rate and emissions from brick kilns around. Moreover, transboundary episode may also have influence on the PM levels during these months. It is also observed that all the gaseous pollutant except NO₂ in BARC and Rajshahi CAMS did not exceeded the BNAQS. In case of NO₂ concentrations 11 and 2 days were found non-attainment at BARC, Dhaka and Rajshahi CAMS respectively.

In general PM pollution levels in the cities monitored during the reporting month was less hazardous compared to previous month in respect of public health. Usually in the dry seasons the pollution level reached its peak gradually which is reflected in the data monitored by CAMS. It observed that average wind speed compared to previous month of February 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 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 2013 were mainly from south-east to south-west direction.

4. Summary and conclusion

Data obtained from 10 CAMS out of 11 CAMS operated under DoE air quality monitoring network during March 2013 have been analyzed and reported. Data availability was over 80% for all the criteria pollutant monitored at different CAMS except Sangshad Bhaban, where CO data availability was only around 20%. From the analysis of the data following conclusion can be drawn:

- PM₁₀ and PM_{2.5} are the most critical pollutants and 24-hour average for both PM₁₀ and PM_{2.5} exceeded the BNAQS for majority of days in March 2013.
- Gaseous pollutants except NO₂ did not exceeded limit values at all the CAMS. NO₂ concentration exceeded the limit values for 12 and 2 days at BARC, Dhaka and Rajshahi CAMS respectively.
- PM concentrations (both PM₁₀ and PM_{2.5}) are expected to be influenced by emissions from transport and brick kilns. Transboundary episodes may also have impact for higher PM levels.
- Due to increased average wind speed during March dispersion of pollutants increased and help decreasing the pollution concentration levels.

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

Table 3: Summary Air Quality and Meteorological data measured during March 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	8.50	11.58	12.30	17.40	22.80	DNA	8.09	7.09	2.27	20.83	38.56
			Max	23.79	24.85	42.33	41.44	62.78	DNA	14.73	12.14	4.66	31.40	69.02
			Min	3.62	3.78	1.81	5.46	5.52	DNA	3.51	3.61	0.75	11.43	3.16
			Excedance(Days)	0	0	0	0	0	DNA	0	0	0	0	0
			Data capture(%)	100.00	78.36	67.07	96.91	97.31	DNA	98.92	96.77	81.32	88.31	56.32
NO ₂ -24 hr	ppb	53 (Annual)	Average	7.99	50.79	24.68	11.05	4.57	DNA	14.98	11.13	18.50	32.13	2.15
			Max	37.59	91.82	42.56	23.26	12.56	DNA	27.52	15.52	21.18	106.62	7.56
			Min	0.06	22.11	11.22	0.12	0.08	DNA	4.96	6.73	17.54	8.54	0.06
			Excedance(Days)	0	11	0	0	0	DNA	0	0	0	2	0
			Data capture(%)	46.24	81.72	95.43	81.32	67.20	DNA	98.92	96.64	85.75	78.23	54.84
CO- 1 hr	ppm	35	Average	0.47	1.49	4.27	2.11	0.66	DNA	1.25	2.71	2.20	1.28	0.93
			Max	1.23	7.74	7.91	6.02	3.16	DNA	4.97	6.06	7.43	5.77	5.14
			Min	0.06	0.06	3.10	0.80	0.06	DNA	0.70	1.72	0.06	0.20	0.06
			Excedance(Hour)	0.00	0.00	0.00	0.00	0.00	DNA	0.00	0.00	0.00	0.00	0.00
			Data capture(%)	17.61	76.61	97.45	96.91	95.83	0.00	98.92	96.77	80.78	91.40	93.68
CO-8hr	ppm	9	Average	0.44	1.42	4.29	2.09	0.65	DNA	1.25	2.70	2.17	1.27	0.95
			Max	1.18	7.35	7.15	4.24	2.56	DNA	3.00	4.41	7.04	3.24	4.95
			Min	0.05	0.07	3.15	1.03	0.06	DNA	0.79	1.91	0.06	0.44	0.09
			Excedance(Hour)	0.00	0.00	0.00	0.00	0.00	DNA	0.00	0.00	0.00	0.00	0.00
			Data capture(%)	18.95	86.16	98.12	98.12	98.79	0.00	99.06	99.06	95.56	97.72	96.91
O ₃ -1hr	ppb	120	Average	5.29	26.17	15.85	17.65	10.50	DNA	18.37	24.44	9.92	29.07	12.54
			Max	25.29	90.25	73.55	65.99	58.78	DNA	81.66	64.16	49.10	83.42	34.06
			Min	2.03	9.04	1.78	2.40	1.48	DNA	0.38	3.28	0.35	0.16	0.06
			Excedance(Hour)	0.00	0.00	0.00	0.00	0.00	DNA	0.00	0.00	0.00	0.00	0.00
			Data capture(%)	100.00	82.53	95.43	96.91	97.31	0.00	98.92	96.51	86.42	90.73	43.82
O ₃ -8hr	ppb	80	Average	5.31	27.07	15.83	17.94	10.42	DNA	18.49	24.23	10.27	29.52	12.47
			Max	21.69	74.11	62.62	52.34	43.25	DNA	70.37	56.54	37.41	77.21	26.07
			Min	2.11	9.77	2.14	2.69	1.59	DNA	0.80	3.78	0.66	0.30	0.06
			Excedance(Hour)	0.00	0.00	0.00	0.00	0.00	DNA	0.00	0.00	0.00	0.00	0.00
			Data capture(%)	99.06	86.96	98.12	98.12	99.06	0.00	99.06	99.06	96.91	97.72	44.62

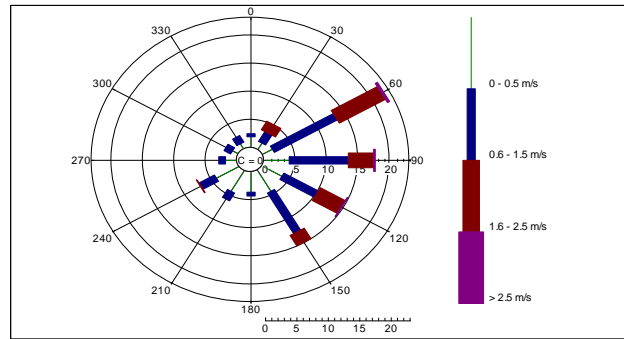
CAMS= Continuous Air Monitoring Station, DNA= Data Not Available, NA= Not Applicable, PM= Particulate Matter,
a=All CAMS are under refurbishment, NAAQS=National Ambient Air Quality Standard

Table 3: Summary Air Quality and Meteorological data measured during March 2013 at different CAMS operated under DoE (Cont'd)

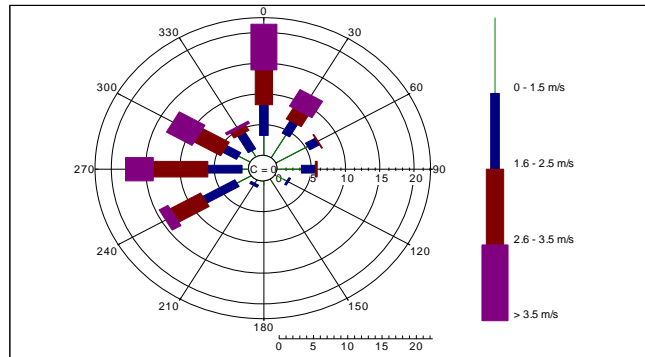
Parameter	unit	NAAQS	Summary	CAMS-1 (S-Bhaban)	CAMS-2 (BARC) ^a	CAMS-3 (D-salam)	CAMS-4 (Gazipur)	CAMS-5 (Narayonganj)	CAMS-6 TV-St (Chittagong) ^a	CAMS-7 Agrabad-(Chittagong)	CAMS-8 (Sylhet)	CAMS-9 (Khulna) ^a	CAMS-10 (Rajshahi) ^a	CAMS-11 (Barisal)
PM _{2.5} -24hr	µg /m ³	65	Average	88.06	104.97	130.20	130.77	115.56	DNA	100.90	100.17	81.23	102.72	85.09
			Max	161.09	221.91	261.77	225.55	294.00	DNA	173.60	139.04	207.47	174.61	236.74
			Min	46.56	49.72	65.27	77.39	49.00	DNA	46.85	70.05	42.17	45.33	41.78
			Excedance(Days)	22	22	31	31	12	DNA	27	31	17	29	16
			Data capture(%)	88	78.09	97	96	16	0.00	98	96	84.95	88.31	91.40
PM ₁₀ -24hr	µg /m ³	150	Average	165.71	172.90	247.54	232.30	235.18	DNA	193.83	179.32	153.35	212.72	133.75
			Max	294.15	361.20	464.79	395.22	386.88	DNA	271.77	240.80	525.66	311.72	381.79
			Min	85.88	95.21	121.26	124.77	99.03	DNA	98.41	125.91	36.53	84.51	62.38
			Excedance(Days)	16	14	27	28	21	DNA	20	24	13	8.00	9
			Data capture(%)	100	82	96	96	95	0.00	69	96	78.63	14.38	93.15
Solar rad. 1hr	watt/ m ²	NA	Average	163.33	DNA	236.17	219.62	186.48	DNA	195.69	211.16	DNA	DNA	210.03
			Max	778.96	DNA	1042.72	895.97	875.31	DNA	848.05	853.50	DNA	DNA	844.97
			Min	5.86	DNA	7.20	6.92	3.96	DNA	7.42	5.91	DNA	DNA	7.59
			Data capture(%)	100.00	82.53	97.45	96.91	97.31	0.00	98.92	96.77	81.18	0.00	94.09
Relative Humidity 1hr	(%)	NA	Average	58.43	42.48	61.31	61.71	46.22	DNA	69.96	61.55	73.43	55.90	64.62
			Max	94.79	64.00	93.97	95.32	56.99	DNA	94.85	95.45	100.00	65.55	94.83
			Min	18.54	20.02	30.05	17.49	18.68	DNA	35.30	22.76	20.28	46.39	21.86
			Data capture(%)	100.00	82.53	85.89	96.77	97.31	0.00	92.34	96.77	85.62	89.65	94.22
Ambient Temp. 1hr	(°c)	NA	Average	26.95	DNA	27.07	28.76	21.50	DNA	26.28	26.78	26.93	20.96	30.12
			Max	36.01	DNA	35.54	39.75	27.95	DNA	32.73	34.08	35.76	34.99	39.48
			Min	16.49	DNA	12.58	14.92	15.42	DNA	19.08	17.84	17.55	8.24	19.08
			Data capture(%)	100.00	82.53	93.55	96.77	97.31	0.00	98.39	96.77	85.62	31.99	93.82
Rainfall 1hr	(m.m.)	NA	Average	0.04	1.55	0.11	0.04	0.02	DNA	0.06	0.03	0.18	DNA	0.01
			Max	4.61	5.99	4.18	2.69	1.93	DNA	2.31	3.85	1.08	DNA	0.04
			Min	0.01	0.01	0.01	0.01	0.01	DNA	0.01	0.01	0.01	DNA	0.01
			Data capture(%)	100.00	67.61	93.82	96.91	89.11	0.00	98.66	95.03	83.06	0.27	74.60

CAMS= Continuous Air Monitoring Station, DNA= Data Not Available, NA= Not Applicable, PM= Particulate Matter, a=All CAMS are under refurbishment, NAAQS=National Ambient Air Quality Standard

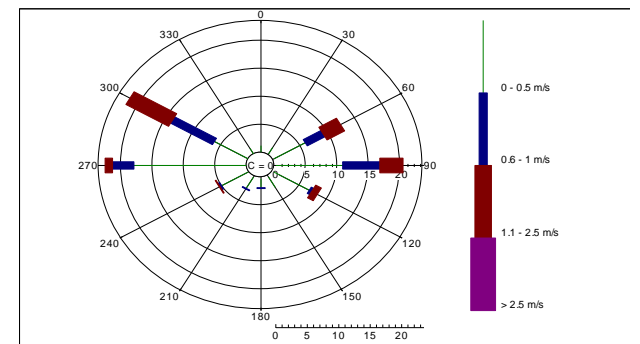
Wind Rose of Narayonganj CAMS for this month



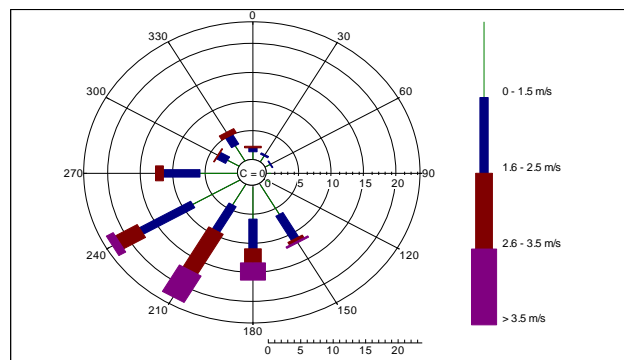
Wind Rose of Agrabad, Chittagong CAMS for this month



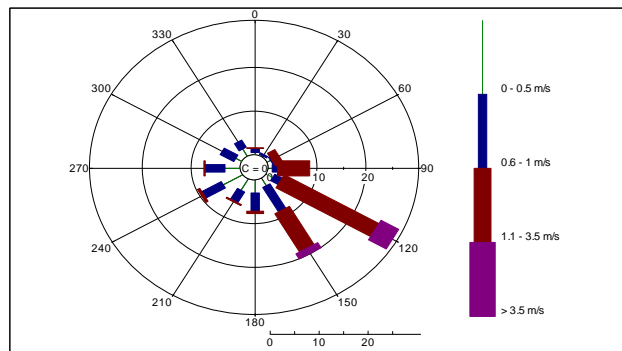
Wind Rose of BARC CAMS for this month



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

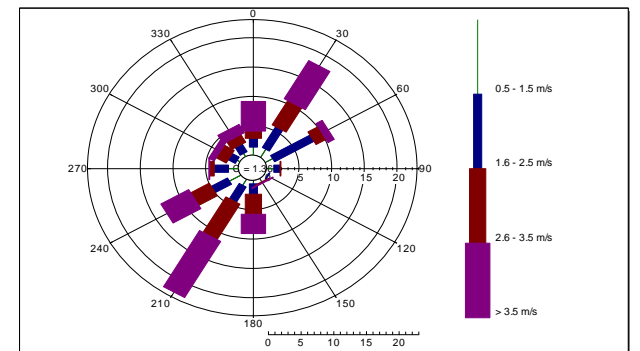
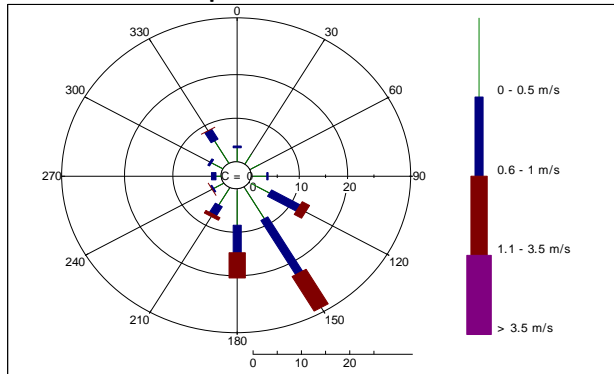
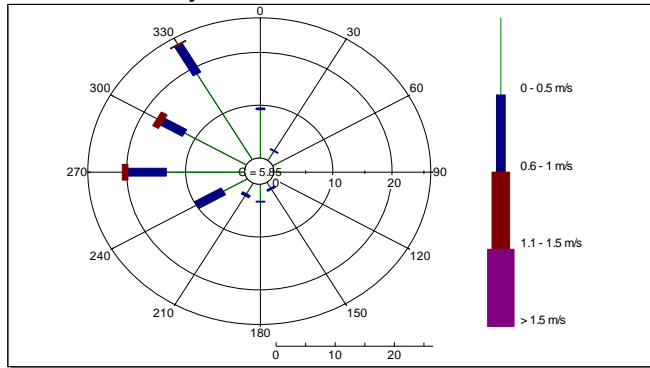


Figure 2: Wind frequency distributions (wind roses) from different CAMS monitored for March 2013.

Wind Rose of Gazipur CAMS for this month

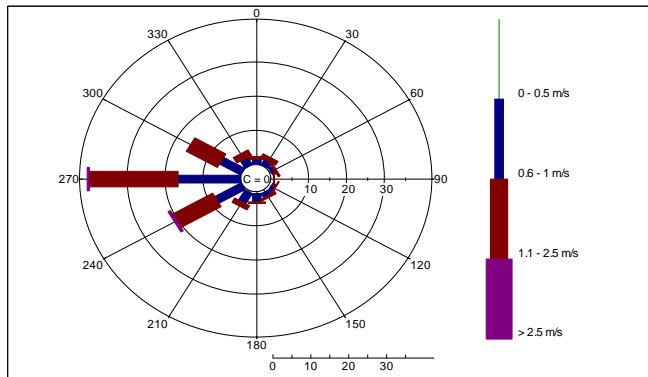


Wind Rose of Rajshahi CAMS for this month



Wind Rose of Khulna CAMS for this month

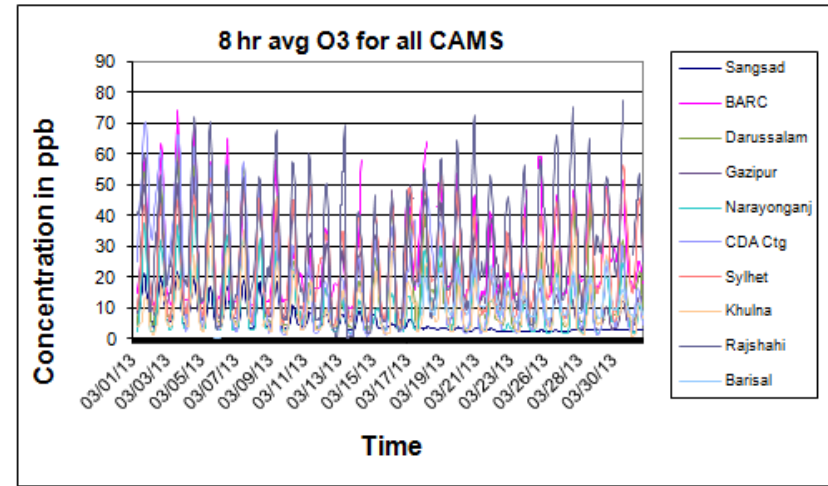
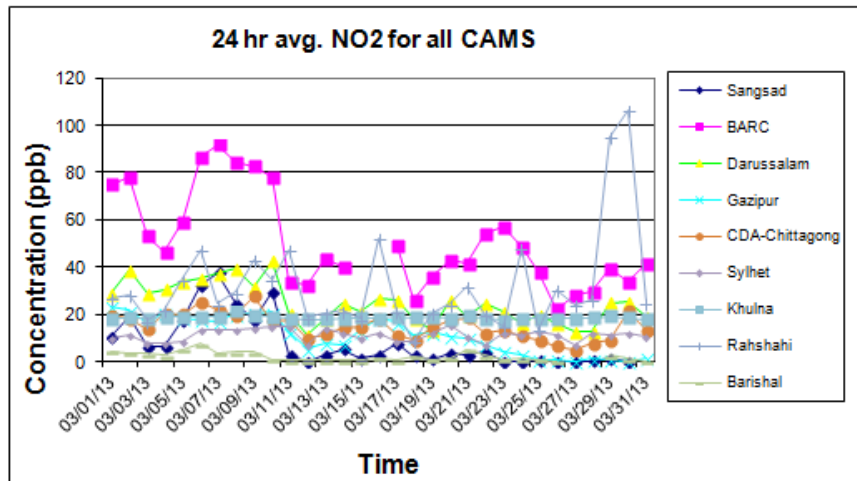
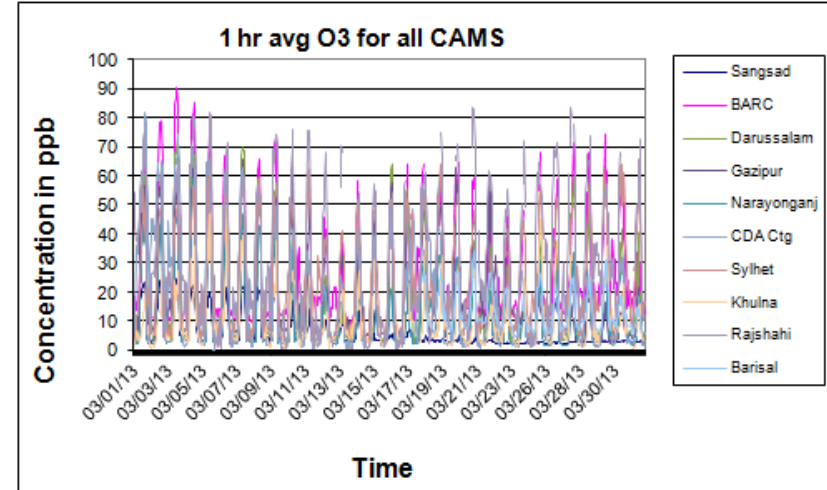
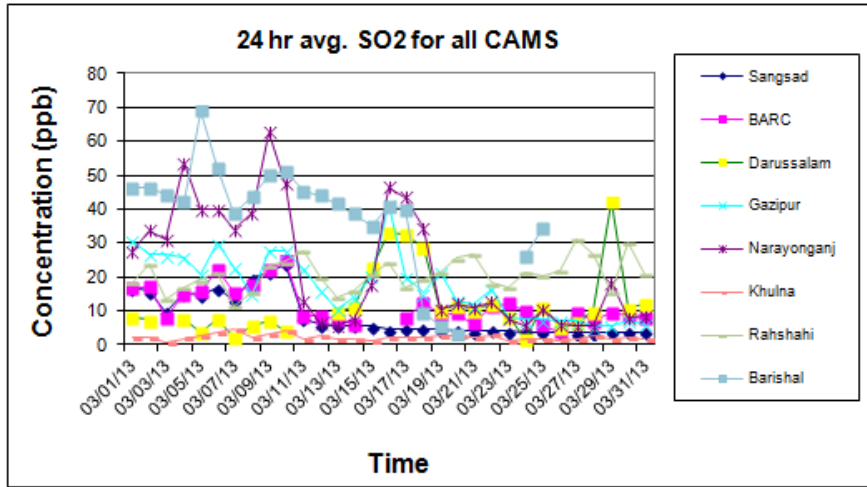
Wind Rose of Barisal CAMS for this month



Wind Rose of TV-Chittagong CAMS for this month

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

TIME SERIES OF ALL PARAMETERS (SO₂, NO₂ and O₃) MEASURED IN ALL CAMS DURING MARCH 2013



TIME SERIES OF ALL PARAMETERS (CO, PM10 and PM2.5) MEASURED IN CAMS DURING MARCH 2013

