ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

ANALYSIS OF AMBIENT AIR QUALITY IN GUWAHATI CITY – A CASE STUDY

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DOI: 10.5281/zenodo.49747

ABSTRACT

This study reports the analysis of the ambient air quality at six different locations in Guwahati city. It investigates the concentration of the pollutants - Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Nitrogen Dioxide (NO_2) and Sulphur Dioxide (SO_2) for the months of April, May and June 2014. Six sampling sites (Industrial, Residential and Urban) were selected on the basis of different parameters like population density, meterological data etc.

The sites selected were Bamunimaidam, Khanapara, Boragaon, Jalukbari, Santipur and Ulubari.

The Air Quality Index (AQI) was calculated using Indian Air Quality Index (IND-AQI) procedure. It revealed that SPM and RSPM are mainly responsible for polluting the environment at different locations in Guwahati city. The concentration of gaseous pollutants namely SO_2 and NO_2 were under the permissible limits as per National Ambient Air Quality Standards (NAAQS), Central Pollution Control Board (CPCB) while the concentration of particulate pollutants (SPM and RSPM/PM10) were higher than the permissible limits as per CPCB.

KEYWORDS: Ambient air quality, Air Quality Index, SO_2, NO_2, SPM, Guwahati.

INTRODUCTION

Air pollution is considered to be primarily an urban problem in Guwahati city as the rate of urbanization increases. Growing air pollution has emerged as a serious concern in the city with vehicular emission and dust contributing a major share of the deteriorating air quality.

In rural areas, air quality is considered to have been negatively affected with areas adjacent to industrial estates or isolated industrial plants set up outside city limits. The notion of maintaining good air quality has been the focus of attention among concerned stakeholders in Guwahati. The Pollution Control Board, Assam (PCBA) has been monitoring the city's ambient air quality under the National Air Quality Monitoring Programme (NAMP) and has recorded high levels of air pollution in all its monitoring stations in the city.

Under N.A.M.P., four air pollutants namely, Sulphur Dioxide (SO_2), Nitrogen dioxide (NO_2), Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM/PM_{10}) have been identified for regular monitoring at all the locations.

The monitoring of pollutants is carried out for 16 hours (4-hourly sampling for gaseous pollutants i.e. SO_2 and NO_2 and 8-hourly sampling for particulate matter i.e. SPM and RSPM) on all working days of a week.

The problem of air pollution in the Guwahati city is mainly because of vehicles and small and medium-scale industries. With more and more people these days purchasing private vehicles, the energy consumption (fossil fuel) and SO_X, NO_X emissions have increased tremendously. According to reports, more than 400,000 vehicles ply on Guwahati's roads every day and approximately 70% of these vehicles don't have emission clearance certificates. So majority of the vehicles plying on Guwahati roads could be emitting excessive amounts of toxic pollutants. The

other reason which is affecting Guwahati city is unplanned and open burning of solid waste disposal right in the city itself.

Therefore an attempt was made to represent the overall air quality in the form of Air Quality Index (AQI). AQI is a tool, introduced by Environmental Protection agency (EPA) in USA to measure the levels of pollution due to major air pollutants. In the present study the AQI was calculated using IND-AQI.

The Indian Air Quality Index (IND-AQI) is useful in indicating the day to day changes in air quality.

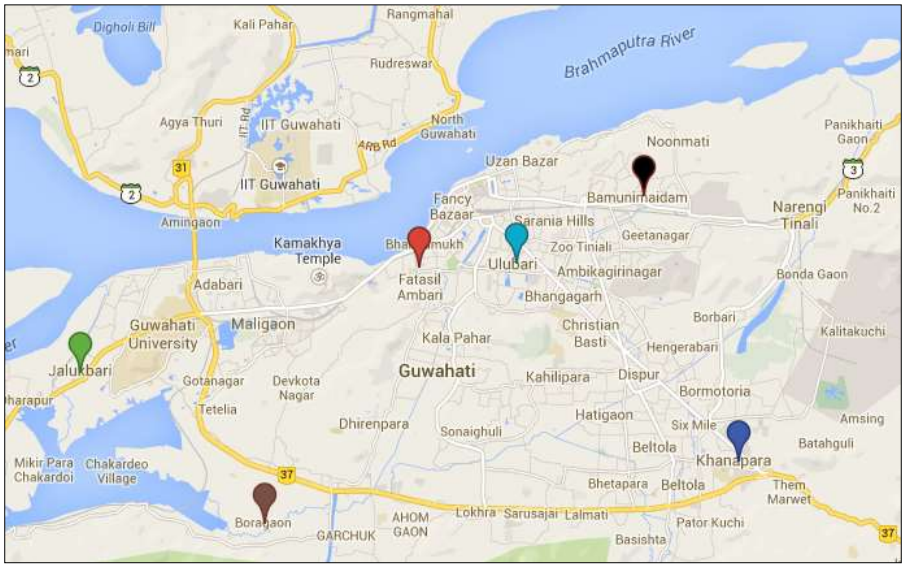


Figure 1: Map of the study area

MATERIALS AND METHODS

Monitoring in Guwahati city was carried out at six sites namely industrial at Bamunimaidam, Khanapara and Boragaon, commercial at Jalukbari and Ulubari, residential at Santipur. Sampling was carried out at the six different locations using Respirable Dust Samplers APM 460NL along with the gaseous pollutant monitoring APM 411 attached to the Respirable Dust Sampler. The collected samples were analyzed for various parameters using standard methods prescribed by central pollution control board (CPCB). Particulate matter that is SPM and RSPM were estimated by gravimetric method. Air-borne suspended particulates are measured by passing air at a high flow-rate of 1.1 to 1.7 m^3/min through a high efficiency filter paper (Whatman 934-AH Glass Microfiber Filters) which retain the particles. Gaseous pollutants namely SO_2 and NO_2 were collected on four hourly basis and were analyzed by (West and Geake) and (Jacob and Hochheiser) method respectively. Concentrations of the pollutants were measured in micrograms/cubic meter ($\mu g/m^3$). In the present study the AQI was calculated using IND-AQI.

S.No	Index	Category	SO_2 (24 hr avg) ($\mu g/m^3$)	NO_2 (24 hr avg) ($\mu g/m^3$)	SPM (24-hr avg.) ($\mu g/m^3$)	RSPM (24-hr avg.) ($\mu g/m^3$)
1	0-100	Good	0-80	0-80	0-200	0-100
2	101-200	Moderate	81-367	81-180	201-260	101-150
3	201-300	Poor	368-786	181-564	261-400	151-350
4	301-400	Very poor	787-1572	565-1272	401-800	351-420
5	401-500	Severe	>1572	>1272	>800	>420

Table 1: Sub-index and breakpoint pollutant concentration for Indian Air Quality Index (IND- AQI)

Calculation for IND-AQI included first calculation for sub-indices, which was made by using following equation (*Chattopadhyay et al., 2010*):

$$Q = 100 (V/Vs) \quad (1)$$

Where, Q = Quality Rating

V = Observed values of the parameter and

Vs = Standard value recommended for the parameter

If "n" numbers of parameters are considered, the Geometric Mean of these "n" numbers of Quality Rating is found out and this is considered as Air Quality Index (AQI).

$$g = \text{anti log } \{(\log a + \log b + \ldots\ldots\ldots\ldots \log x)/n\} \quad (2)$$

Where, g = geometric mean;

a, b, c, d, x = different values of air quality rating; and

n = number of values of air quality rating,

log = logarithm.

Out of all sub-AQIs, the highest value becomes the overall index and reported as IND-AQI.

RESULTS AND DISCUSSION

The average concentration values of the pollutants SPM, RSPM, SO_2, NO_2 for the months of April, May and June 2014 have been plotted in graphs for the six industrial, urban and residential sites of Guwahati.

The results of the investigation showed that the concentrations of SPM for six stations ranged from 282 $\mu g/m^3$ to 491 $\mu g/m^3$, 85 $\mu g/m^3$ to 206 $\mu g/m^3$ and 74 $\mu g/m^3$ to 146 $\mu g/m^3$ in the months of April, May and June respectively with highest SPM concentration in April. The SPM values of all the monitoring stations for the months of April and

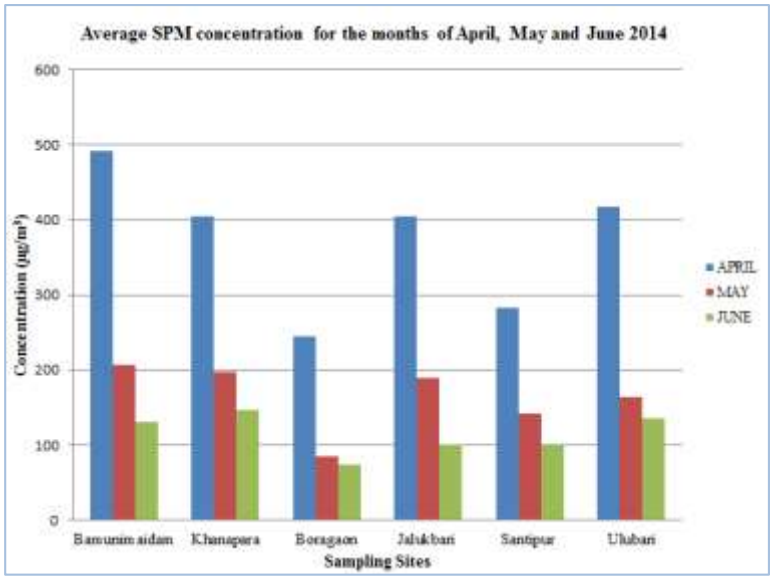
May were above the permissible limit 100 µg/m^3 declared by revised NAAQS, CPCB, 2009-10. The reason behind may be the flow of high winds during the month of March-April raising the dust levels in ground level air. Further high winds also raise fine particulates from ground soil which increases the dust load of air. In June, the SPM concentrations for all locations were above the standard limits except for location Boragaon area, which was well within the prescribed limit. The high SPM concentration indicates the pollution load of that area.

Concentrations of RSPM for six stations ranged from 153 µg/m^3 to 236 µg/m^3, 33 µg/m^3 to 107 µg/m^3 and 44 µg/m^3 to 89 µg/m^3 in the months of April, May and June respectively with high RSPM concentrations at Khanapara, Jalukbari and Ulubari locations in April month. The RSPM values of all the monitoring stations for the months of April were above the permissible limit 100 µg/m^3 declared by revised NAAQS, CPCB, 2009-10. The sources of this pollutant may be transportation, industries and high rate of combustion of conventional fuels. The sand along the sides of the roads, which is dusty in nature, is not removed periodically. Also processes like tire wear, brake wear and road surface wear can lead to the deposition of particles on the road surface. The other process is the re-suspension of road dust which is due to traffic induced turbulence, tire friction or the action of the wind.

However RSPM concentrations for the month of May and June were found to be within prescribed limits except for Bamunimaidam location. Decreasing trend in RSPM levels during these two months may be due to the monsoon season.

Concentrations of SO_2 for six stations ranged from 7 µg/m^3 to 8 µg/m^3, 7 µg/m^3 to 9 µg/m^3 and 6 µg/m^3 to 8 µg/m^3 in the months of April, May and June respectively. The SO_2 values of all the monitoring stations are found to be well within the prescribed limit set by CPCB (80µg/m^3).

Concentrations of NO_2 for six stations ranged from 14 µg/m^3 to 19 µg/m^3, 14 µg/m^3 to 18 µg/m^3 and 11 µg/m^3 to 16 µg/m^3 in the months of April, May and June respectively. The NO_2 values of all the monitoring stations are found to be well within the prescribed limit set by CPCB (80µg/m^3).Hence, it could be seen that the SPM, RSPM, SO_2 and NO_2 had dissimilar degree of air pollution with different concentrations for all the six locations in the three months. This may be due to diverse sources of air pollution in the sampling stations and the varied micro-meteorological conditions.



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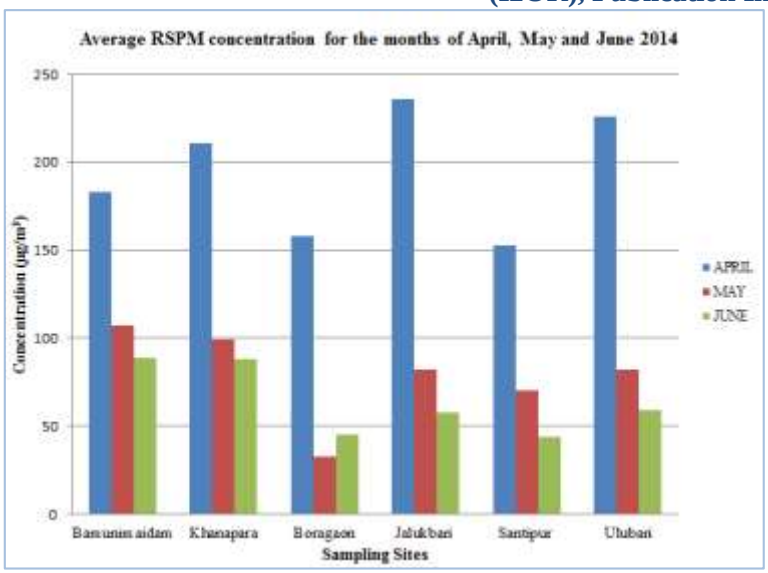

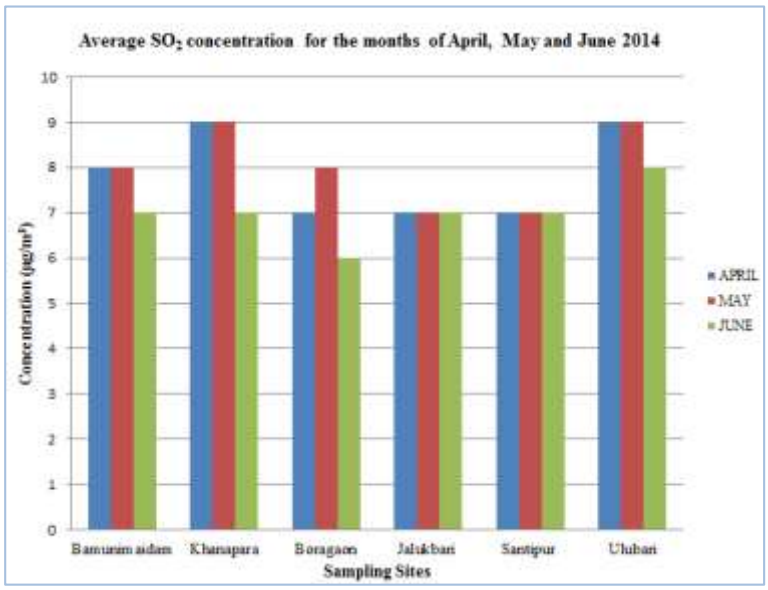

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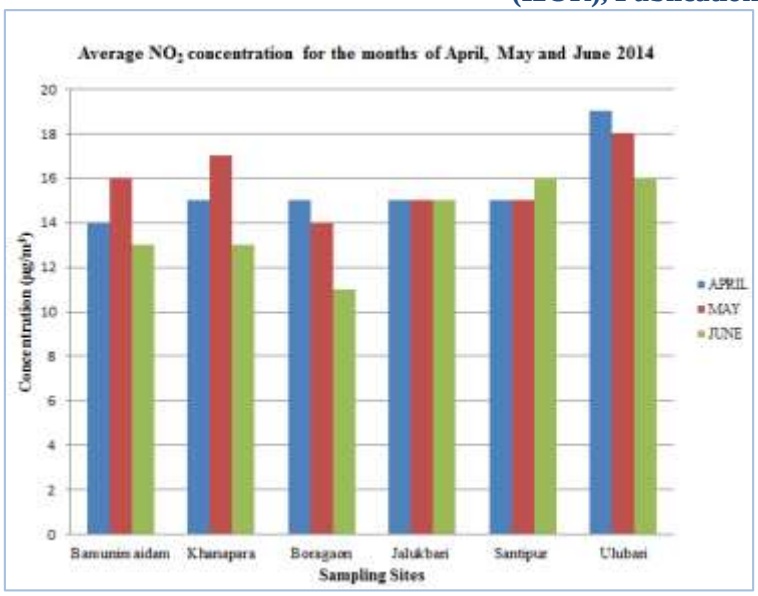

On comparison of the Indian Air Quality Index (IND-AQI) values for all the three months of April, May and June 2014, the IND-AQI value for all locations in the month of April were found to be of much higher value with respect to the other two months. The IND-AQI value for April month ranged from 153 to 245.7 and this fell under the category of "Poor" to "moderate". This is usually dangerous as people might experience various health effects. SPM and RSPM were found to be the main air pollutant responsible for this poor air quality. Bamunimaidam and Ulubari being industrial and commercial sites had very poor air quality with SPM and RSPM being the responsible pollutant. In the month of May and June, the air quality index was found to be within the prescribed limits of IND-AQI for all six locations.

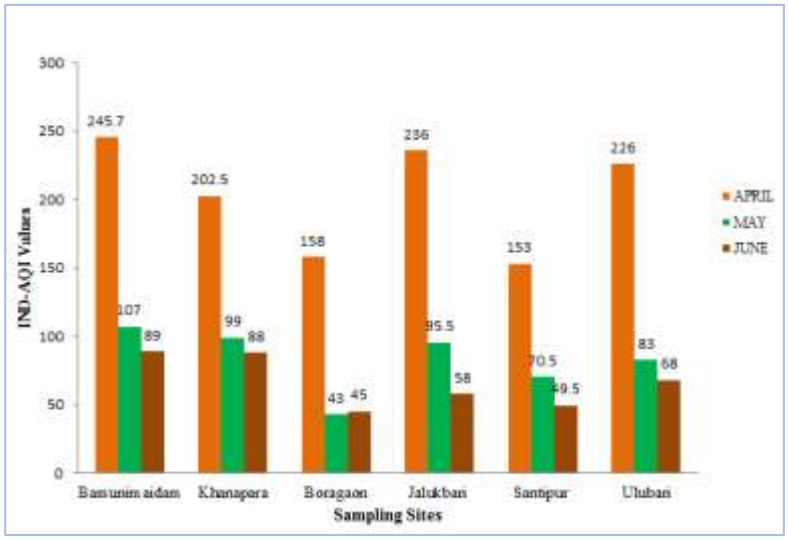

Figure 2: IND-AQI values for April, May and June 2014

CONCLUSION

The overall Air Quality Index (AQI) can give a clear view about the ambient air and the critical pollutant responsible for air pollution. The AQIs were calculated to assess the ambient air quality at six different locations of

Guwahati city categorized into industrial, commercial and residential sites during the month of April, May and June 2014.

Sampling was done on all working days of a week at the particular sites for SPM, RSPM/PM10, SO2 and NO2. Concentration obtained of SPM and RSPM at all sites were above standard levels laid down by CPCB during the month of April.

During the month of April 2014, the industrial and commercial sites at Bamunimaidam, Khanapara, Jalukbari and Ulubari have concentration of SPM above 400 $\mu g/m^3$ which were above the prescribed limits (200 $\mu g/m^3$) and sites at Boragaon and Santipur were found to be within the permissible values.

Concentrations of RSPM at all locations were found to be above 150 $\mu g/m^3$ which were much above the prescribed limit (100 $\mu g/m^3$) of National ambient Air Quality Standards (NAAQS, 2009-10, CPCB).

The detection of heavy metals like chromium, cadmium, lead and zinc in the RSPM samples could trigger lung diseases which are also carcinogenic in nature. Lead attacks the central nervous system and continuous inhalation of lead residues in the air could also poison the blood.

SO_2 and NO_2 concentration for the month of April at all sites were within standard limits.

During the month of May and June, it was seen that SPM concentration for Bamunimaidam, Khanapara, Jalukbari and Ulubari were near to 150$\mu g/m^3$ but were under the prescribed limits. Locations at Boragaon and Santipur were much below the prescribed limits.

The RSPM values for all locations were below 100$\mu g/m^3$ and within the standard levels laid down by CPCB except for Bamunimaidam area which showed a higher value. The reason behind may be due to set up of a few carbon and steel industries located in this place.

SO_2 and NO_2 concentration at all sites for these two months were within the prescribed limits.

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IND-AQI values were calculated for each site to check different levels of pollution among different sampling sites within study area.

During the month of April, highest AQI value is found to be 245.7 at site near Bamunimaidam followed by Ulubari area with an AQI value of 226. The values come under poor category which may have detrimental effects on human health and members of sensitive groups may experience more serious health effects.

The AQI study reveals that SPM and RSPM were mainly responsible for polluting the environment at all sites in Guwahati. The majority of AQI values of SPM and RSPM fall under the category of unhealthy to poor. The major reasons for unhealthy particulate matter concentration are the growing vehicular pollution in the city, frequently occurring dust storms, unorganized infrastructural development, the refineries and the petrol pumps. It was reported that the high concentration of RSPM in all commercial sites was due to plying of diesel vehicles. The dust produced through clutch plates, brakes, tyres also increase the range of particulate matter in urban air. It is seen that the concentration of gaseous pollutants namely SO2 and NO2 were under the permissible limits as per CPCB while the concentration of particulate pollutants (SPM and RSPM/PM10) were higher than the permissible limits as per Central Pollution Control Board (CPCB).

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