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Short Communication

Study of Air Pollutant over Jaipur, Rajasthan, India

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Abstract

The present study investigates the concentration of air pollutants (SPM, PM_{10}, NO_2, SO_2) at Ajmeri Gate over Jaipur during the period of 2011-14. The daily and monthly means of SPM, PM_{10}, NO_2, SO_2 concentrations have been determined from RSPCB air pollution datasets for the year 2011-2014. The PM_{10} levels at the AG sites are found to exceed the prescribed limits as given by National Ambient Air Quality Standards (NAAQS). The value of PM_{10} and SPM shows the high variability over both sites during the study period. The concentration of PM_{10} was found higher than the standard value (100 $\mu g/m^3$) for about 60 % of observations. It was also observed the value of NO_2 and SO_2 were well below the standard limit.

Keywords: AG, PM_{10}, NO_2, SO_2, SPM.

Introduction

In the twenty-one century, the Air quality status is becomes one of the serious issues in all over the world. The concern about air quality is increasing day by day. The rapid urbanization and industrialization are responsible for the air quality deteriorating of a particular place. The air quality is in alarming condition at national as well as at state level. The air quality is defined as the air at a particular place is pollution-free. The term "air quality" describes the condition of the air around us. In the developing countries, the air quality is one of the biggest concerns for a human being. The air pollutants may generate from the natural sources as well as human activities. On an average, a person inhales about 20,000 liters of air every day. With every breath which is inhaled by the person, there is a risk of being inhaled the dangerous chemicals with the breath which can affect human being lives. The vehicular air pollution has not only very serious affects on health of a human beings but also very harmful for the ecological system. The air pollutants have the ability to travel long distances due to their small size and mass. The increased air pollutant concentrations in an urban area are responsible for deficits in pulmonary functions, cardiovascular disease, neurobehavioral effects, morbidity and mortality[1,2].

The various studies found that increase in human population raises the demand of industries; road transport and vehicular traffic for the comfort as well as for the luxurious life of people but this increase in demand play a major role in the deterioration of air quality. It is estimated that air pollution is responsible for the death of 1.4% of all deaths and 0.8% disabilities. In India, Central Pollution Control Board (CPCB) notified a new set of Indian National Ambient Air Quality Standards (INAAQS)[3] for 12 parameters CO, SO_2, NO_2, particulate matter (PM) of less than 10 microns size (PM_{10}) and less than 2.5 microns size ($PM_{2.5}$), NH_3, Pb, O_3, C_6H_6, Ni, As and Benzo(a)Pyrene (BaP). Sulphur di oxide (SO_2) is a gas formed when fuel containing sulphur is burnt, like coal and oil. Nitrogen Oxides (NO_X) is highly reactive gases contain various levels of nitrogen and oxygen. These parameters are the indicator of air quality of a particular area. Particulate Matter (PM) is a complex mixture of suspended liquid and solid particles in the air that differ in size and composition. The concentration of particulate matter (PM) is very high in major cities of India. The concentration of PM_{10} found more than two times than National Ambient Quality Standards (NAAQS) in Delhi during last December and January. Air quality standards are the basic foundation that provides a legal framework for air pollution control.

Table-1
Indian National Ambient Air Quality Standards (units: $\mu g/m^3$ unless mentioned otherwise)

Pollutant	SO_2	NO_2	$PM_{2.5}$	PM_{10}	O_3		CO (mg/m^3)		Pb	NH_3
Averaging time (hr)	24	24	24	24	1	8	1	8	24	24
Standard	80	80	60	100	180	100	4	2	1	400

Various studies show that the motor vehicle produces more air pollutants than any other single human activity. The major anthropogenic sources of air pollutants are industrial emissions, domestic fuel burning, emissions from power plants and transportation activities.

Therefore, the air quality monitoring is needed in order to provide useful information about the pollution and can take appropriate measures to mitigate the negative impact whenever it is necessary. The object of monitoring the air quality over urban location is not only to collect the air quality data but also provide the information which is required by the scientist, planners, policy makers to make a decision on improving and managing the environment[4].

Materials and Methods

Study Area: The measurement site is located at Jaipur lies between 26'52" to 26'57" N and 75'47" to 75'52" E. Jaipur is known as the "Pink City" and is the capital of Rajasthan, India. Jaipur District has the total area of 11,117 sq. km. with an average population density of 470 people per sq. km. The total population of Jaipur city was found to be 3,073,350 in census 2011[5]. Jaipur city experiences hot and semi-arid climate with the highest temperature during May- June to be 42-45° C[6,7].

Site description: Ajmeri Gate (AG) was selected as monitoring sites in the study area. Ajmeri Gate is known as high traffic volume area. The probable source of the air pollutant (SPM, PM_{10}, NO_2, SO_2) at AG from vehicular emission.

Results and Discussion

The present study analyses the air pollutant concentration (SPM, PM_{10}, NO_2, SO_2) at Ajmeri Gate of Jaipur. The main focus of this work is to analyze the air pollutant concentration at high traffic.

Diurnal variation of air pollutant over Ajmeri Gate (AG) during 2011-14: The daily concentration of SPM, PM_{10}, NO_2 and SO2 at AG is shown in Figure-1. The daily mean concentration ranged from 4.0×10^1 µg/m^3 to 1.52×10^3 µg/m^3, 1.9×10^1 µg/m^3 to 7.05×10^2 µg/m^3, 2.4×10^1 µg/m^3 to 6.6×10^1 µg/m^3 and 3.0 µg/m^3 to 1.3×10^1 µg/m^3, respectively during the study period. Further, it was observed that the average value of these pollutants were $3.03\times10^2\pm1.32\times10^2$ µg/m^3, $1.34\times10^2\pm6.98\times10^1$ µg/m^3, $4.3\times10^1\pm1.05\times10^1$ µg/m^3 and 7.0 ±2.04 µg/m^3, respectively during 2011- 2014.

The value of PM_{10} was seen to exceed the permissible limit (100µg/m^3) which ultimately causes various health problems for human beings. The value of NO_2 and SO_2 were below the permissible limit but the value of SPM was very high at the monitoring sites among all four pollutants. The minimum and maximum value of PM_{10} and SPM was found 19 µg/m^3, 40 µg/m^3 and 7.05×10^2 µg/m^3, 1.52×10^3 µg/m^3 on 07 September 2012 and 20 March 2012 respectively. The high concentration of PM and SPM was found during 20th March 2012 due to an early South Asian dust storm[8].

Monthly variation of air pollutant at Ajmeri Gate: The monthly variations of air pollutant i.e. SPM, PM_{10}, NO_2, SO_2 at the monitoring site AG were analyzed shown in Figure-2. The values of PM_{10} and SPM were recorded high. The concentration of PM_{10} and SPM varies between 5.2×10^1 µg/m^3 to 2.4×10^2 µg/m^{3}and 1.47×10^2 µg/m^3 to 5.35×10^2 µg/m^3 respectively. The concentration of PM_{10} was above the standard limit (51 µg/m^3 to 100 µg/m^3) which varies from 5.2×10^1 µg/m^3 to 2.4×10^2 µg/m^3. The concentration of PM_{10} was found higher than the NAAQS. The maximum and minimum value of $PM_{10}$was found during March 2012 and August 2011. The concentration of SPM was found maximum and minimum during March 2012 and July 2013. The monthly value of NO_2 and SO_2 concentration were well below the standard limit. It ranged from 2.63×10^1 µg/m^{3}to 6.35×10^1 µg/m^3 and 4.8 µg/m^{3}to 1.31×10^1 µg/m^3, respectively.

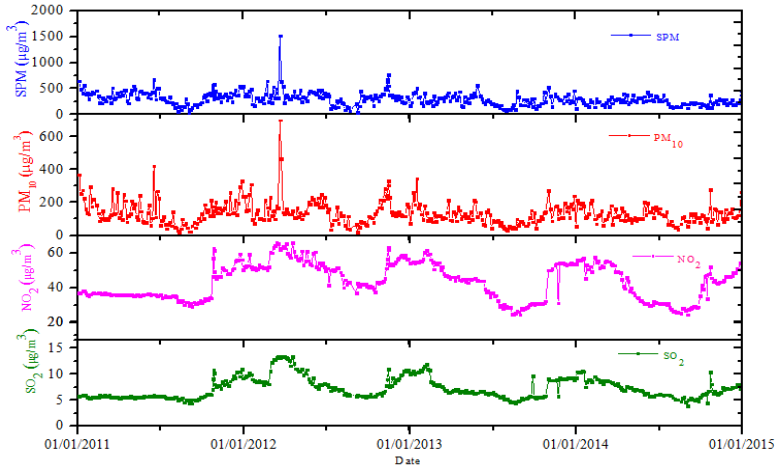

Figure-1
Daily variation of air pollutant at Ajmeri Gate during 2011-2014

The average value of SPM, PM_{10}, NO_2, SO_2 were 3.0×10^2 µg/m^3, 1.33×10^2 µg/m^3, 4.3×10^1 µg/m^{3}and 7.0 µg/m^3 respectively. The minimum value of NO_2 and SO_2 was found during August 2013 while maximum value was found during March 2012.

Comparison of air pollutant concentration with NAAQS: This study further explored the concentration of air pollutant over AG and compares the concentration of these pollutants with standard NAAQS data. This study shows that the concentration of PM_{10} was found higher than standard value (100 µg/m^3) for about 60 % of observations, on the other hand, the concentration of NO_2 and SO_2 was found within the permissible limit over AG.

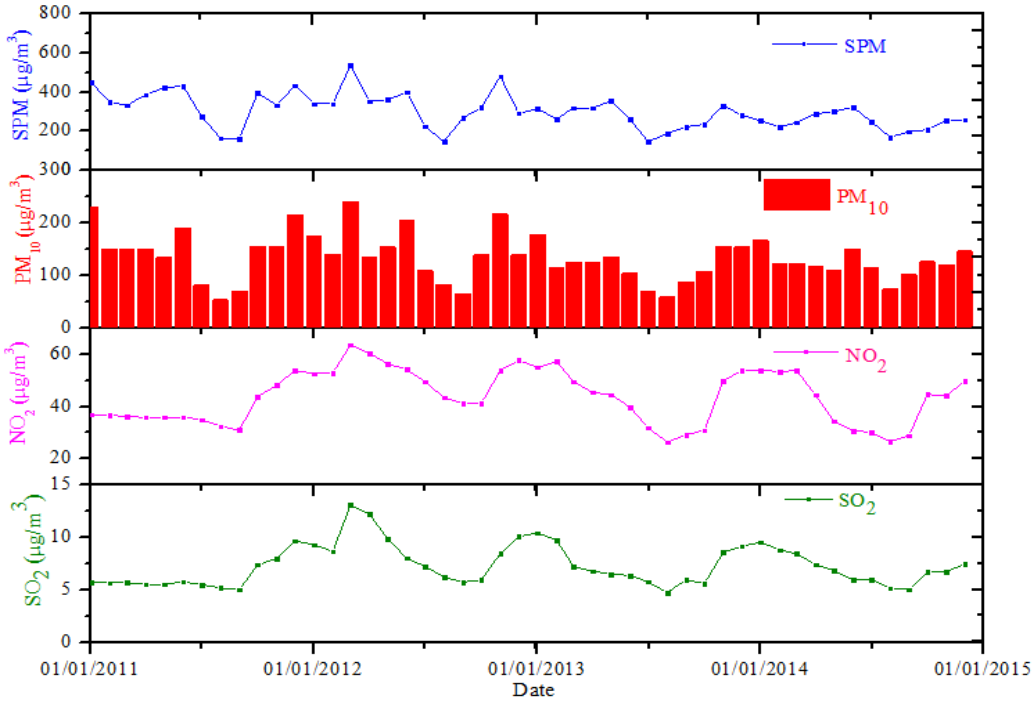

Figure-2
Monthly variation of air pollutant at Ajmeri Gate during 2011-2014

Table-2
Comparison of air pollutant with NAAQS

Pollutants	Standard	AG		Month	
	(µg/m^3)	Max. (µg/m$^{3)}$	Min. (µg/m$^{3)}$	Max.	Min.
NO_2	< 80	63.5	26.3	March, 2012	August, 2013
PM_{10}	< 100	239.2	52.7	March, 2012	August, 2011
SO_2	< 80	13.1	4.8	March, 2012	August, 2013
SPM	-	535.6	147.7	March, 2012	July, 2013

Conclusion

The study on air quality status was carried out for AG (Heavy traffic and Market area) located in Jaipur city. The concentration of air pollutants (PM_{10}, SPM, NO_2 and SO_2) over these two sites at Jaipur were collected and investigated to know the level of air pollution which affects the health of people in Jaipur city.

This study reveals that the concentration of particulate matter and SPM were higher at the monitoring sites AG. The value of PM_{10} varies from 1.9×10^1 µg/m^3 to 7.05×10^2 µg/m^3 on the monitoring sites in 2011 -2014. The concentration of NO_2 at AG varies from 2.4×10^1 µg/m^3 to 6.6×10^1 µg/m^3 during the study period. The concentration of PM_{10} was found minimum and maximum during monsoon and summer season, respectively. The probable sources of PM_{10} and SPM in Jaipur are construction activities, industrial activities, and increase in vehicle demand, vehicular emission, and road dust. The minimum and maximum concentrations of SO_2 at AG were found 3.89 µg/m^3 to 13.47 µg/m^3.

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