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Analysis of O_3, CO and NO_2 concentration by using Ambient Air Analyzers during the summer season

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ABSTRACT

In the atmosphere, ozone (O_3) act as a prime source which can easily fluctuated the natural conditions. The ground level or tropospheric O_3 is a secondary pollutant, other than this NO_2 is also a secondary pollutant but CO is primary pollutant. Summer season mainly fluctuated the concentration level very sharply. As a result, the summer average of O_3 concentration was higher in 2013 (51 ppb), whereas CO was more in 2014 (0.55 ppm) and the level of NO_2 was maintained in both the years (11 ppb). While observing daily average in summer it found that O_3 concentration was higher with moderate CO and NO_2 concentration.

Key Words: CO, NO_2, O_3, Primary pollutant, Secondary pollutant, Tropospheric O_3

INTRODUCTION

Today, the level of tropospheric O_3 has been destructed day by day. The concentration of ozone and other gaseous pollutants (CO and NO_2) can be fluctuating due to some outdoor activities of human beings. High concentrations by human activities (largely the combustion of fossil fuel) make O_3 a pollutant and a constituent of smog. Thus, Carbon monoxide (CO) acts as a primary pollutant whereas; ozone (O_3) is a secondary pollutant.

Scientifically, O_3 is present in the ambient air that we inhale but the amount of O_3 concentration is very low i.e. 0.001-0.003 ppm. When the concentration level exceeded from the respective amount it causes harmful effects on humans, vegetation even on climate. Concentration of ozone may be varying with season as well as with topography. During the summer season,

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concentration of gaseous pollutants rapidly fluctuated *(Sarkar, 2015)* and without any variation O_3 concentration goes up ward, whereas; CO and NO_2 fluctuated with respect to O_3 concentration.

Sheel et.al. (2010) has been acknowledged the comparison of satellite observed tropospheric NO_2 over India with model simulations. Data taken from the satellite compared with tropospheric NO_2 by using a chemical transport model (MOZART) the data obtained from Global Ozone Monitoring Experiment (GOME). Observation notices that, during 1996-2006 rate of industrialization and vehicular traffic has tremendously increased which observed by GOME and SCIAMACHY (Scanning Imaging Absorption Spectrometer for Atmospheric Cartography).

The diurnal and seasonal characteristics of ozone and NOx over a high altitude Western Ghats location in Southern India has found that ozone and NOx concentrations were higher during warmer months. The seasonal variation in ozone was maximum (62 ppb in March) in summer with values sometime exceeding 90 ppb and a minimum in the monsoon and post monsoon season (17 ppb in August). On the contrary, lower ozone mixing ratio was observed during the daytime *(Udayasoorian et.al. 2013).* A monthly maximum NOx value was observed during summer month of April (1.85ppb), whereas minimum value was observed during monsoon (0.19 ppb in August).

Jeelani (2014) has observed the annual average of diurnal and seasonal variations of surface ozone and its precursors (O_3, NO, NO_2, NOx, SO_2, CO, CH_4, TNMHCs and THC) in the atmosphere of Yanbu, Saudi Arabia and found the concentration level of 22.51 ppb, 15.58 ppb, 17.25 ppb, 23.84 ppb, 6.66 ppb, 165.13 ppb, 3.44 ppm, 0.56 ppm and 3.88 ppm, respectively. Ozone concentration during diurnal cycle was highest in daytime whereas lowest in

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nighttime. The O_3 and NO have higher concentrations in autumn and winter than summer and spring seasons.

In between November 2009 to December 2011 an observational study of surface O_3, NOx, CH_4 and Total NMHCs at Kannur, India has done by *Nishanth et.al. (2014)*. It was found that the surface O_3 concentration was higher in afternoon and declined at night. The maximum and minimum mixing ratio of surface O_3 was observed in winter and monsoon. NOx concentration was exceeded during mid-night to early morning and low during noontime. The diurnal variations of mixing ratios for NOx and O_3 were anti-correlated. In December the monthly average of CH_4 concentration was maximum (2.26 ± 0.44 ppmv) whereas in August it was minimum (0.43 ± 0.19 ppmv).

Diurnal and seasonal variabilities in surface ozone at a high altitude site Mt. Abu has measuring the surface ozone, CO and oxides of nitrogen in 1993-2000. Result said that, throughout the year oxygen mixing ratio was declined. Some metorological parameters are responsible for the seasonal and diurnal variations. During the continuous monitoring of ozone, 90 ppbv of average ozone mixing ratio was found *(Naja et.al. (2003)*.

SIGNIFICANCE OF THE STUDY

The study is significant to gain information about the ambient air quality of the city Jabalpur. The observation has continuously monitored by AAQMS (Ambient Air Quality Monitoring System). In the upcoming years, AAQMS is going to enforce in each city to aware the population about its importance and necessity.

MATERIAL AND METHOD

The Study Area:

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Madya Pradesh is generally known as the heart of India. The site Jabalpur is one of the major centers of Madhya Pradesh in India and is famous for its green belt**.** Geographically, it is located at 23.17°N 79.95°E. It has an average elevation of 411 meters (1348 ft). Topographically Jabalpur is rich with forests, hills and mountains which contain lots of minerals in it. On the other hand, quality of air is getting deteriorated slowly by increasing industrialization and due to tremendous increase in number of vehicles plying on the roads.

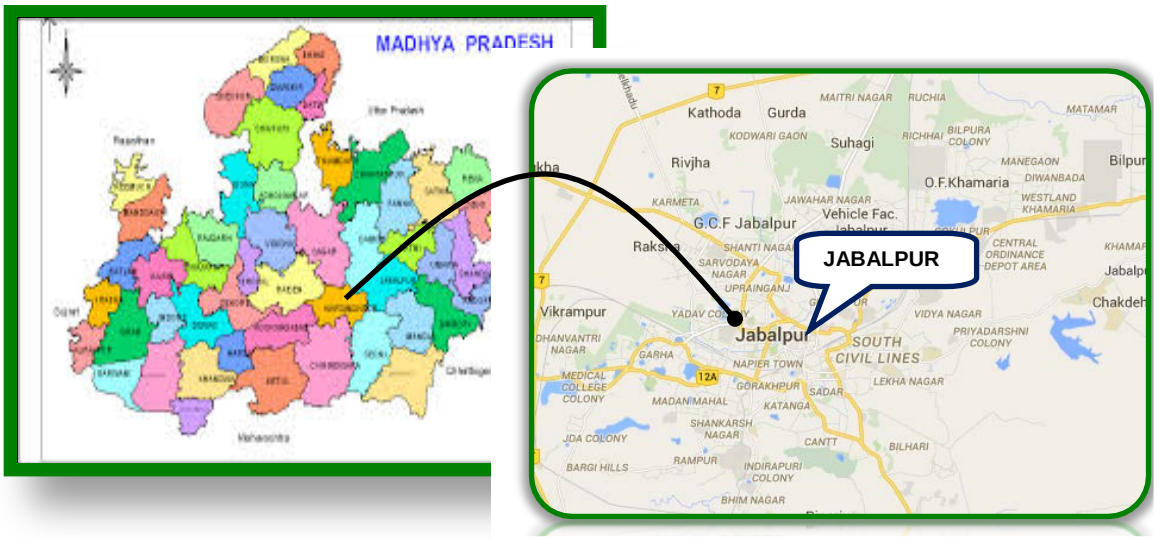

Fig. 1: Location of Jabalpur

Sampling and Investigative method:

The instrument ***Ambient Air Quality Monitoring System (AAQMS)*** was manufactured by ***Ecotech*** Australia. It is systematic, assessment of long term pollutants in the surroundings. ***Ecotech*** established the instrument for environmental monitoring that is WinAQMS (Air Quality Monitoring Station). This WinAQMS has two parts: the client as client and the server. The monitoring system consists of the assembly of many transducers and analyzers employing

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various instrumentation techniques. These are EC9830 Carbon Monoxide Analyzer (CO), EC9810 Ozone Analyzer (O_3), EC9841 Nitrogen Oxides Analyzer (NO_X) and a NO_2 converter.

The NO_2 Converter has been taken the NO signal from the NOx. To obtain accurate and stable results, the converter must operate at above 96% (US-EPA) and (95% Australian standard) efficiency. The Molybdenum converter will operate at nearly 100% efficiency for in excess of 8000 ppm-hours. Maximum conversion at 99% efficiency is 7 ppm NO_2. For higher NO_2 levels a stainless steel converter that operates at 650 ° C is required.

Observation Table:

The study has been analyzed by monitoring the O_3, CO, and NO_2 concentration during the two years of summer season. The variation in O_3, CO and NO_2 concentration has been clearly observed and illustrate that, the variation is not very much fluctuated but nor identical. The summer season has been covered three months of a year i.e. April, May and June.

Fig. 2: Comparative average of O_3 concentration of summer

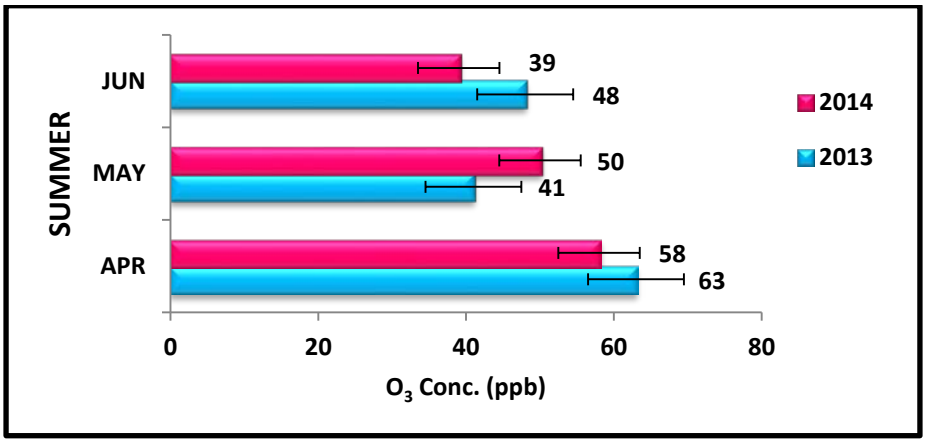

Fig. 3: Comparative average of CO concentration of summer

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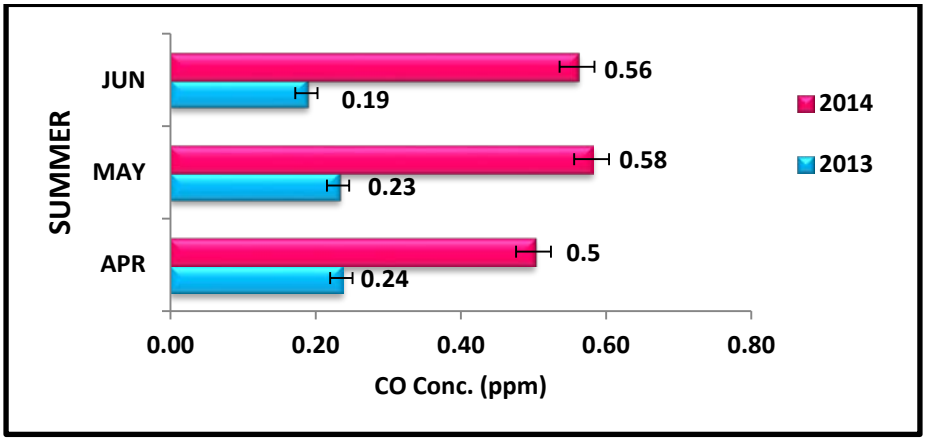
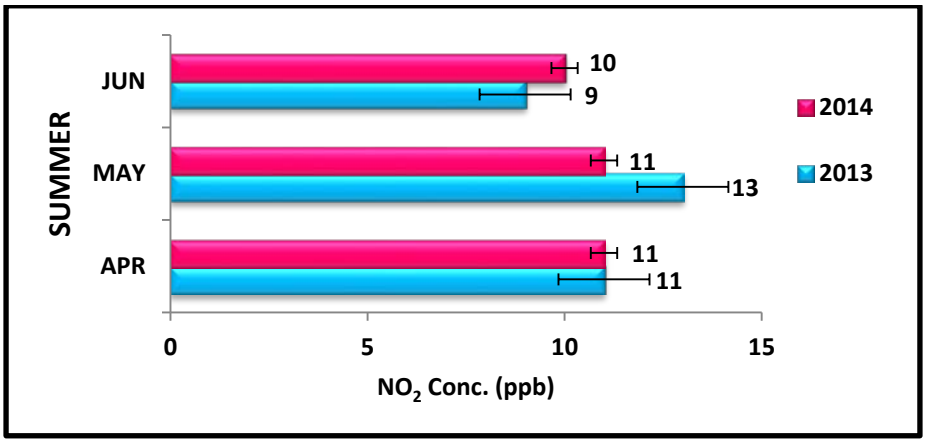


Fig. 4: Comparative average of NO_2 concentration of summer



The average of the three months separately belongs to summer season reflects its increasing concentration level in each year. As per fig. 2, O_3 concentration was more in 2013 than 2014. It has always seen that, in the initial period of summer O_3 concentration was higher than gradually next month. In the other hand, CO was shown high variation in the comparison, because in 2014 the concentration level of CO was too high than in 2013 (from fig. 3). As similar like CO, NO_2 also shown higher concentration at the month of May (from fig. 4) out of whole summer months. From this, it can be easily understood that all the pollutants are mainly dependent on their atmospheric temperature.

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However, the concentration of O_3, CO and NO_2 little bit fluctuate throughout the summer season. This variation may be take place due to other gaseous pollutants as well as meteorological parameters. For a better result, all the data has been monitored continuously.

Fig. 5: Daily monitoring of O_3 concentration during the summer season

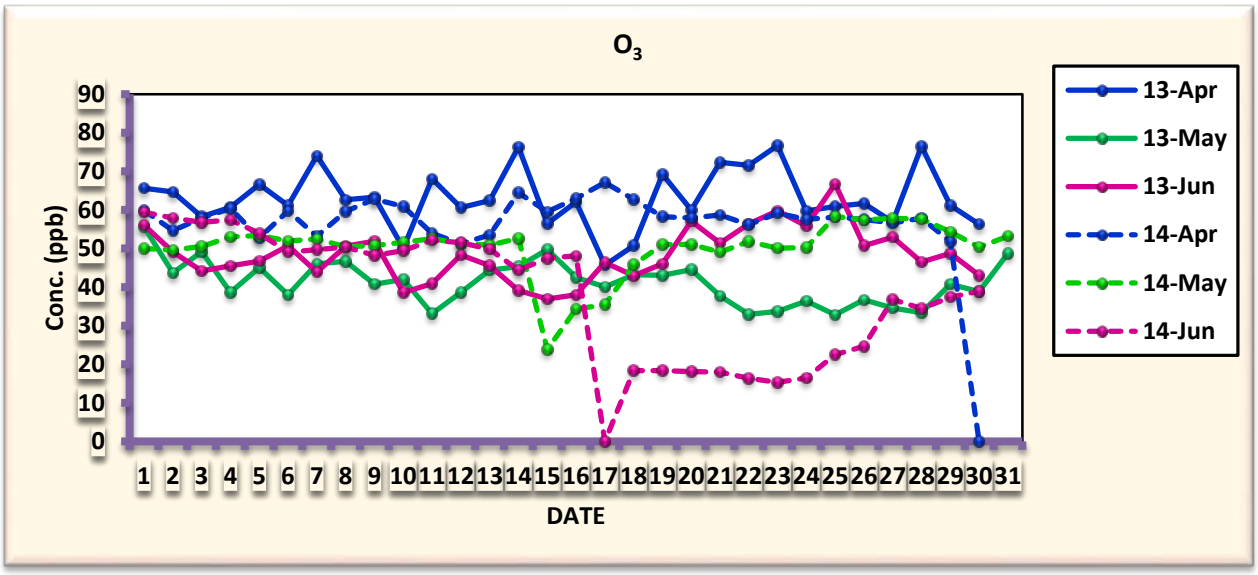

Fig. 6: Daily monitoring of CO concentration during the summer season

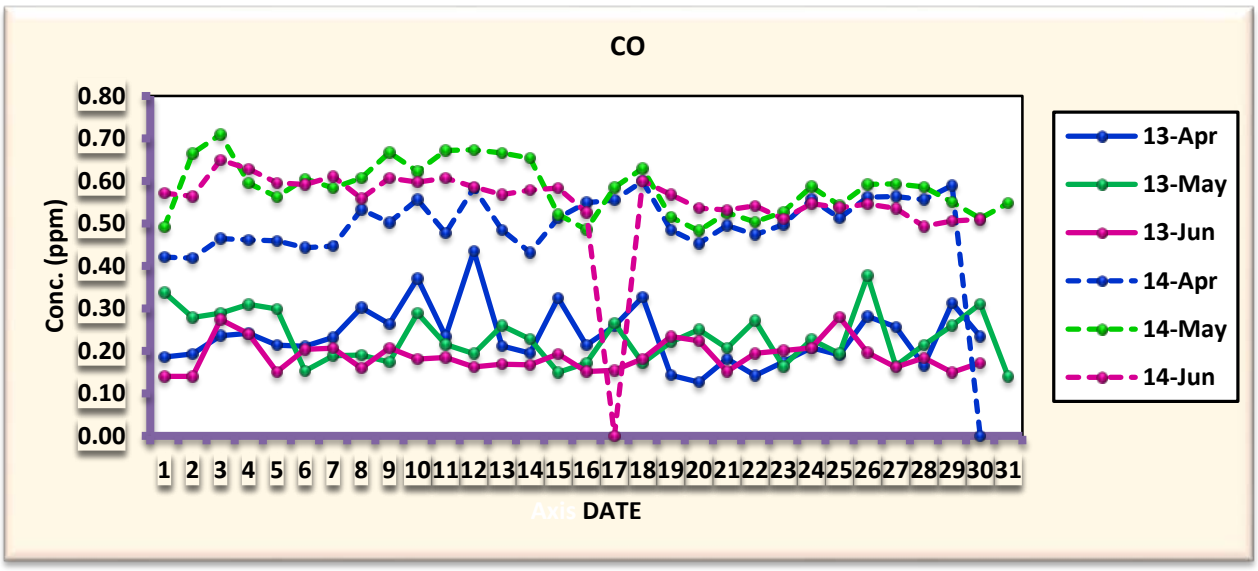

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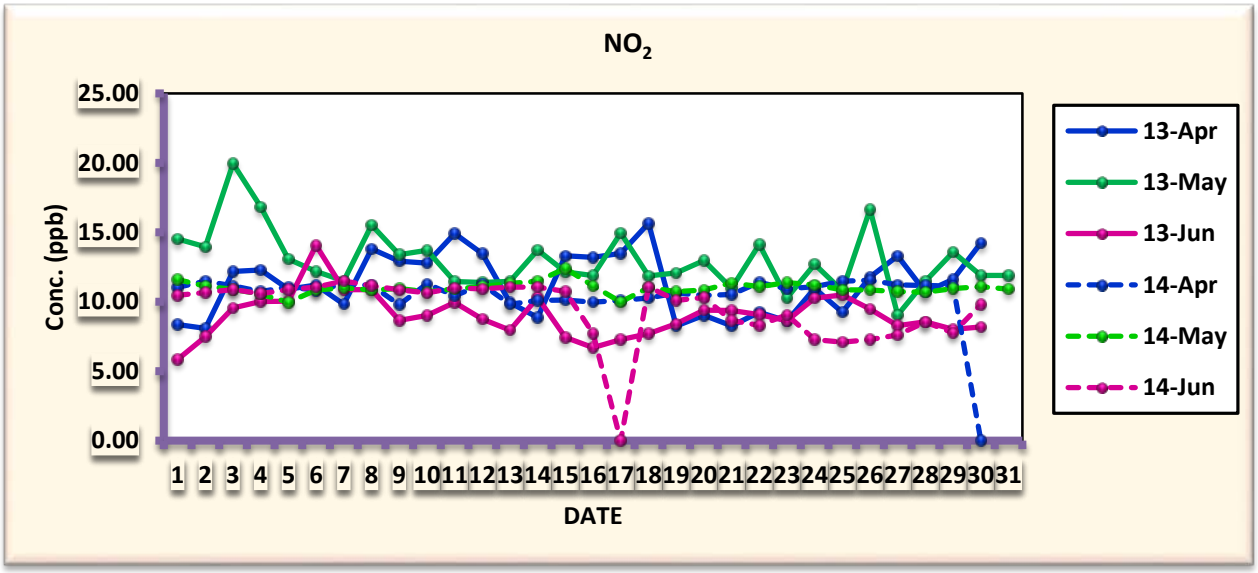
Fig. 7: Daily monitoring of NO_2 concentration during the summer season



The observation indicates that in 2013, when Concentration of O_3 was higher simultaneously the concentration of CO was higher whereas, NO_2 shown moderate concentration. Whereas, in 2014, CO was higher in the mid of summer, at that period from fig. 4, 5, 6; it clarify that O_3 and NO_2 was moderate. Thus, this variation is may be due to the fluctuation in its concentration and simultaneous all other factors must be responsible.

RESULT

The gaseous pollutants O_3 and its precursor gases: CO and NO_2 were not independent to maintain their concentration. The entire external as well as neighboring factors were playing a essential role. The concentration of O_3, CO and NO_2 were varying in the summer. The summer average concentration of all the respective gases is here under:

Table 1: Comparative average of O_3, CO and NO_2 of summer season

AVERAGE OF SUMMER		
YEAR	2013	2014
O_3 (ppb)	51	49
CO (ppm)	0.22	0.55

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NO_2 (ppb)	11	11

The concentration of O_3 in the summer season shows higher in 2013 (63 ppb) whereas lowest in 2014 (39 ppb), as per seen in fig. 3. The comparative study of CO found that, the concentration level shown tremendous variation from 2013(very low) to (very high) 2014(fig. 4). But NO_2 concentration was initially in 2013 and 2014, shows similar concentration (11ppb) and later on it gradually taken a bit fluctuation.

While seeing the daily average of summer season it was found that, O_3, CO and NO_2 were interrelated with each others concentration. As a result, it has been observed that in both the years (2013 and 2014) when O_3 level was higher; the concentration level of CO was moderate with a little bit more less concentration of NO_2.

CONCLUSION

A developing city like Jabalpur needs small initiation to undertake the big need to fight, with the gradually increasing pollution. For the above mentioned purpose the monitoring of ambient air quality in every season is the best way to make people aware of the exact condition for the pollution level of the city. Through the study O_3, CO, and NO_2 of Jabalpur (2013 and 2014) during the summer season reflects the current level of exceeding air pollution in the atmosphere.

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