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The particulate matter concentration around the Golden Temple, Amritsar, Punjab

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ABSTRACT

Particulate matter is a complex mixture and includes both organic and inorganic particles and formed in the atmosphere by the natural and anthropogenic activities. Apart from affecting the climate these particles have adverse affect on the human health. In this paper, we seek to determine particulate matter around Golden Temple, Amritsar. The correlation has been studied between the mass concentrations of PM_{10} and $PM_{2.5}$, and the impact of meteorological parameters on their concentration has been studied. The monthly variations of PM_{10} and $PM_{2.5}$ are also investigated. The highest concentration of PM_{10} has been found in the month of October (~ 300 $\mu g/m^3$) and lowest in the month of April (~ 61$\mu g/m^3$). Whereas the highest concentration of $PM_{2.5}$ (~195$\mu g/m^3$) was observed in the month of May and lowest concentration was in the month of April (37 $\mu g/m^3$). The exceedence factor (EF) for the month of October (PM_{10}) and May ($PM_{2.5}$) is ~3. Such a high EF shows that air is highly polluted and it lies in the critical pollution zone. The main reason of such a high concentration was stubble burning, industrial emission and vehicular pollution.

Key Words:- Golden Temple, Particulate Matter (PM_{10}, $PM_{2.5}$), Exceedence Factor

I. INTRODUCTION

Particulate matter is a complex mixture and includes both organic and inorganic particles, such as dust, pollen, soot, smoke, and liquid droplets suspended in air. These particles vary greatly in size, composition, and origin. The mass and composition of particulate matter (PM) in environments is considered to be divided into two principal groups: coarse particles and fine particles. The barrier between these two fractions of particles usually lies between 1 µm and 2.5 µm. However, the limit between coarse and fine particles is sometimes fixed by convention at 2.5 µm in aerodynamic diameter ($PM_{2.5}$) for measurement purposes. These are formed in the atmosphere by the natural and anthropogenic activities. These particles have adverse affect on the human health [1-2].

Punjab state straddles India's border with Pakistan and is often referred to as the country's "bread basket" because it produces two-thirds of the country's food grains. The rice-wheat crop rotation is very popular with the farmers of state. These combine harvesting techniques in rice-wheat system leaves behind large quantities of straw in the fields. About 81% of rice straw and 48% of wheat straw is burnt in the fields to make way for the next crop [3,4]. The open burning results in perturbations to the regional atmospheric chemistry due to

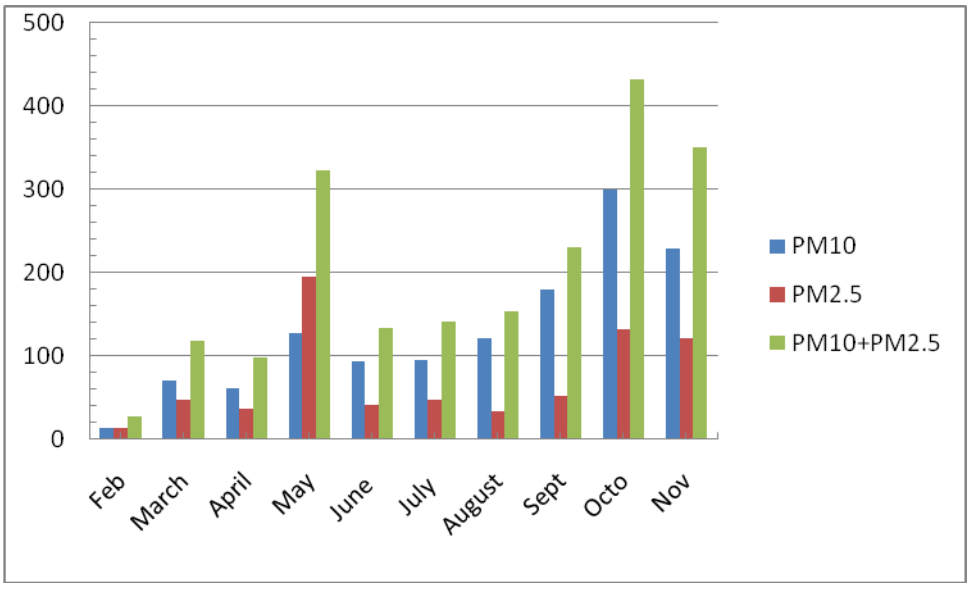
emissions of trace gases and aerosols [5]. Besides this the stubble burning leads to loss of soil fertility. Apart from deteriorating the environment the crop residue burning has adverse effects on human health also.

The Golden Temple is the holiest Sikh shrine and attracts thousands of pilgrims from various parts of the world every day. However, the temple, an architectural marvel, has been losing its sheen due to the rising pollution in and around its vicinity. The high level of pollution in the area is harming miniature paintings and gold-plating, besides leading to the corrosion and blackening of the white marble. The present paper discuss the particulate matter (PM_{10} and $PM_{2.5}$) concentrations around the temple. Further correlation has been studied between the mass concentrations of PM_{10} and $PM_{2.5}$ from these regions (for the period March 2017 to Mid. November 2017) and the impact of meteorological parameters such as temperature and relative humidity on the concentration of PM_{10} and $PM_{2.5}$.

Methodology

The present paper discuss the 24 hour average concentration of PM_{10} and $PM_{2.5}$ around The Golden temple, Amritsar, Punjab. The study region is industrial residential cum rural area. The dataset has been downloaded from the central pollution control board (CPCB) website (http://www.cpcb.gov.in/CAAQM/frmReportdisplay.aspx) [6]. The continuous ambient air quality monitoring instruments has been installed for continuous monitoring of air quality by CPCB and Punjab Pollution Control Board (PPCB) under the National Air Monitoring Programme. In order to study the impact of local meteorology on PM concentration, meteorological parameters such as temperature and humidity at the study region were also collected. In the present paper an analysis was made from a total of 246 available datasets (from March 2017 to Mid. November 2017). The monthly variation of concentrations of PM_{10} and $PM_{2.5}$ at the study regions is shown in figure1.

Fig. 1 The monthly variation of concentrations of PM_{10} and $PM_{2.5}$ around Golden Temple, Amritsar, Punjab.



Further the air quality of different study locations has been compared with respected National Ambient Air Quality Standards (NAAQS) and has been categorized into four categories based on Exceedance Factor (EF) (i) critical pollution when EF >1.5, (ii) high pollution when EF is between 1.0 and 1.5, (iii) moderate pollution when EF is between 0.5 and 1.0 and (iv) low pollution when EF <0.5. Exceedence Factor (EF) is calculated using as:

$$Exceedence\ Factor\ of PM_{10}\ or\ PM_{2.5} = \frac{Observed\ annual\ mean\ concentration\ of PM_{10}\ (or\ PM_{2.5})}{Annual\ Standard\ \ mean\ concentration PM_{10}\ (or\ PM_{2.5})}$$

It has been observed that the EF for PM_{10} and $PM_{2.5}$around the Golden Temple ranges from 0.6 to 3. It is noticed that the upper value of EF lies in the critical pollution zone.

Result and Discussions

In the present study, the monthly variations of the concentration of PM_{10} and $PM_{2.5}$ of Golden Temple, Amritsar, Punjab, India have been studied and its effect on the air quality has been observed. The correlation with the meteorological parameters also has been studied with particulate matters. During the period of observation (March 2017 to Mid. November 2017) the 24 hour monthly average concentration of PM_{10} around the Golden temple was found 142 µg/m^3. The maximum value for the PM_{10} concentration was 300 µg/m^3 and was observed for the month of October. It is because of the fact that in this month along with stubble burning the crackers pollution during Diwali festival contributes towards air pollution. This value is about thrice the National Ambient Air Quality Standards (NAAQS) prescribed by the Central Pollution Control Board (http://www.cpcb.nic.in/National-Ambient-Air-Quality-Standards.php) [7]. As far as the concentration of $PM_{2.5}$ is concerned the 24 hour monthly average concentration during the observation period (March 2017 to Mid. November 2017) was ~78 µg/m^3. The maximum concentration of $PM_{2.5}$ was 195 µg/m^3 and was observed for the month of May and is about three times the NAAQS. Interestingly it has been observed that the maximum concentration of PM_{10} and $PM_{2.5}$ are not for the same month. There is more contribution of PM_{10} during rice stubble burning as compared to $PM_{2.5}$, while during wheat stubble burning there is more contribution of $PM_{2.5}$ as compared to PM_{10}. The $PM_{2.5}$ concentration in the month of May is 1.48 times that of its concentration in the month of October. Further the 24 hour monthly average combined concentration of PM_{10} and $PM_{2.5}$ is observed to be in the month of October followed by the month of May. This clearly shows that there is more air pollution in the month of October, it is because of the rice stubble burning and due to fireworks during the festive season besides other reasons like industrial emission, traffic pollution. As far as the impact of meteorological parameters on the concentration of PM_{10} is concerned, it has been observed that there is small positive correlation of PM_{10} with humidity (0.07) whereas negative correlation was observed between PM_{10} concentration and temperature (-0.04). Further it has been observed that there is positive correlation (0.34) between PM_{10} and $PM_{2.5}$ concentration. However, the situation is quite different if we study the correlation of $PM_{2.5}$ with temperature and humidity. In this case negative correlation (-0.17) was observed between the concentration of $PM_{2.5}$ and humidity whereas a positive correlation (0.05) was observed between $PM_{2.5}$

concentration and temperature. The increasing air pollution has bad impact on the Golden temple, because of increasing pollution the gold plated walls of the temple are losing their shine.

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REFERENCES

[1] Tsiouri V, Kakosimos K, Kumar P (2015) Concentrations, physicochemical characteristics and exposure risks associated with particulate matter in the Middle East area—a review. Air Qual Atmos Health 8:67–80.

[2] Kelly FJ and Fussel JC (2015) Air pollution and public health: emerging hazards and improved understanding of risk. Environ. Geochem. Health 37(4):631-649.

[3] ENVIS Centre, Punjab. Available from http://punenvis.nic.in

[4] Kaur A (2017) Crop Residue in Punjab Agriculture- Status and Constraints. J Krishi Vigyan 5(2): 22-26.

[5] Yang S, He H, Lu S, Chen D, Zhu J (2008), Quantification of crop residue burning in the field and its influence on ambient air quality in Suqian, China. Atmospheric Environment 42 (9):1961–1969.

[6] Central Pollution Control Board. Available from http://www.cpcb.gov.in/CAAQM/ frmReportdisplay.aspx. (accessed 15.11.2017).

[7] National Ambient Air Quality Standards (NAAQS). Available from http://www. cpcb.nic.in/National-Ambient-Air-Quality-Standards.php. (accessed 01.11.2017).