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Impacts of Meteorology on Surface Ozone Variability at Shevgaon

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ABSTRACT

Measurement of surface ozone (O_3) mixing ratio was made from January 2016 to December 2016 in Shevgaon (19.35◦N, 75.22◦E,1669 feet above sea level), India. The monthly average of daytime maximum of O_3 mixing ratio ranged from 17 to 68 parts per billion by volume (ppbv) with an annual average of about 23.5 ppbv. The diurnal variations of O_3 is characterized by maximum of 38.8 ppbv in the afternoon and minimum of 8.4 ppbv early in the morning. Monthly average maximum air temperature and relative humidity (RH) are 33.2 0C and 73% respectively.

Keywords: ozone surface, diurnal variation, meteorological parameters.

INTRODUCTION

Surface ozone O_3 is one of the key trace gases in the atmosphere. Air pollution and climate change have been shown to represent major threats to global food security. Air pollutants like surface ozone that negatively affects human health and agriculture crops yield[1]. In India, a few O_3 measurements studies have been reported [2-4]. They have reported that high O_3 mixing ratio between 34 and 151 ppbv in urban sites. Many studies around the globe have shown that the O_3 in rural locations near the industrial areas have increased significantly[5-6]. The human activites are responsible to increase the O_3 concentrations near the earth surface. In this present

study, we report the diurnal variation of O_3 measured at Shevgaon in the light of meteorological parameters, such as air temperature, RH, cloud cover etc.

Location and Measurements

Fig. 1 represents a map of India with the measuring site-Shevgaon and other major cities. The measuring site is surrounded by four sugar industries namely Gangamai sugar factory, Kedareshwar sahakari sugar factory, Dnyaneshwar sahakari sugar factory, and Shri Vrudheshwar sahakri sugar factory, each is at a distance of 25 km from measurement site and Jayakwadi dam is located on north side .

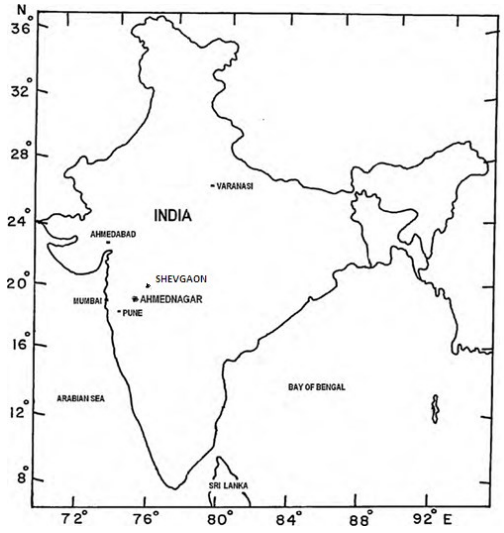

Fig. 1 Location map of the measurement site at Shevgaon.

The sampling site of O_3 is surrounded by cultivated field and some small and big trees. The present population of Shevgaon is about 0.2 millions as per 2011India census and vehicular p opulation nearly 0.02 millions. Aurangabad and Ahmednagar are the nearest metropolitan urban city located at about 80 and 70km in the northeast and south direction.

METHODOLOGY

The Aeroqual Series 500 Monitor have been designed to accurate measurement of ambient gas. Different sensor heads are for specific gases and interchangeable on the same unit. The monitors are modular in design and composed of two main components, a series 500 monitor, and a sensor head. The sensor head is calibrated prior to delivery and does not normally need to calibrated. The concentration can be displayed either in ppm or mg/m^3. The monitor is able to log up to 8000 data points. The data logging interval can be set in one minute increments. In this study, all O_3 analyses are based upon the hourly average data, Indian Standard Time (IST), which is 5:30 h plus Greenwich Mean Time.

RESULTS AND DISCUSSION

Diurnal variations:

It is seen from fig.2 that the O_3 mixing ratio starts increasing after sunrise in the morning, attains maximum during daytime due to photochemical production and again decreases until the next morning. The O_3 reaches to maximum value at noon due to large photochemical production. The corresponding minimum of O_3 mixing ratio 8.4 ppbv was observed at about 07:00 h in the morning. During nighttime, production of O_3 ceases and hence due to lack of sunlight, O_3 decreases throughout the nighttime by chemical loss of O_3, to a lesser extent with nitrate radical (NO_3), and dry deposition at the surface. Therefore, high O_3during summer is only due to both local photochemical production of O_3 and transport of O_3 from upwind northeast and northwest cities.

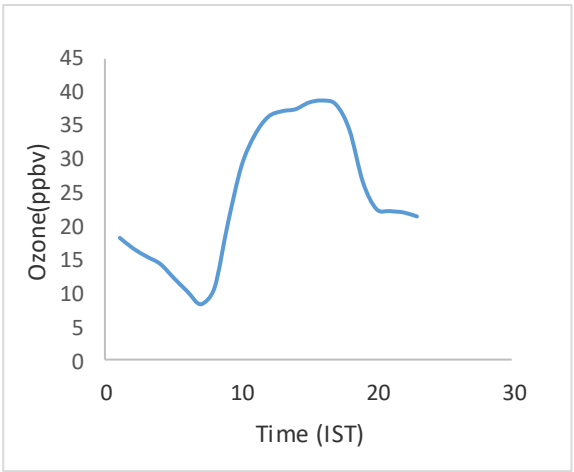

Fig.2 Annual average diurnal variations of O_3 mixing ratio (ppbv) at Shevgaon.

Table1. Monthly average ozone, maximum air temperature, maximum relative humidity (RH), and cloud cover (cc) observed at Shevgaon.

Month	O_3 (ppbv)	Max. air temperature (^{0}C)	Max. RH (%)	Cloud cover (%)
January	21.4	29.8	75	30
February	22.6	32.6	65	25
March	25.7	37.4	44	23
April	30.8	40.9	39	37
May	24.5	40.3	54	43
June	16.6	31.5	69	80
July	11.5	30.2	76	82
August	10.8	28.6	83	87
September	16.3	32.4	80	66
October	19.7	32.8	73	65
November	20.5	31.5	74	41
December	21.3	30.8	75	40
Average	23.5	33.2	73	51.6

Hence, stratospheric ozone intrusion in the troposphere at the ground-level is also ruled out. Therefore, high O_3during afternoon is only due to both local photochemical production of O_3 and transport of O_3 from upwind northeast and northwest cities. In other study [7], similar diurnal variation of O_3 is observed at rural site.

Monthly average ozone along with meteorological parameters:

Table 1 shows the monthly average O_3 mixing ratio along with the meteorological parameters, such as maximum air temperature, maximum relative humidity (RH), and cloud cover (CC) observed at Shevgaon. The highest O_3 mixing ratio (30.8 ppbv) is observed in April. due to maximum air temperature (40.9 0C) and minimum relative humidity (39 %); while lowest O_3 mixing ratio (10.8 ppbv) is observed in August due to minimum air temperature (28.6 0C) and maximum relative humidity(83%); maximum cloud cover (87%). It is clear that meteorological parameters are having important role in the O_3 formation.

CONCLUSION

The monthly average of O_3 mixing ratio ranged from 10.8 ppbv to 30.8 ppbv with an annual average of about 23.5 ppbv. The magnitude of diurnal variation of O_3 mixing ratio was highest in April due to intense solar radiation and high temperature. The RH and cloud cover have shown negative impact on O_3 mixing ratio.

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Conflicts of interest: The authors stated that no conflicts of interest.

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